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Original Article

Internal Medicine Section

Hyperglycaemia, Glycosuria, Ketonuria and their Association with Severity of Organophosphate Poisoning: A Cross-sectional Study

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ABSTRACT

Introduction: Organophosphate Poisoning (OP) is very common in India and presents with features of cholinergic excess. Timely diagnosis and prompt treatment helps in prevention of complications like aspiration pneumonitis, respiratory failure etc. Due to non availability of Pseudo cholinesterase measuring facility at many rural areas and subcentres and as hyperglycaemia, glycosuria and ketonuria are commonly seen in OP poisoning, the study of association of these three parameters with OP poisoning is of utmost importance.

Aim: To study the association of hyperglycaemia, glycosuria and ketonuria with severity of OP.

Materials and Methods: This was a cross-sectional study with a sample size of 120 patients of OP poisoning, who reported to Karnataka Institute of Medical Sciences Hospital, Hubli, from December 2017 to November 2018. Adults >18 years of age with OP poisoning with no pre-existing diabetes were included. Clinical features with Peradeniya Organophosphate Score (POP Score), Complete Blood Count (CBC), Pseudo cholinesterase level, serum amylase, Gylcated Haemoglobin (HbA1c), Random Blood Sugar (RBS), urine ketones, urine glucose levels were obtained. The data was analysed using Chi-square test, Analysis of Variance (ANOVA), paired t-test, Pearson's and Spearman's correlation test.

Results: Majority of the study population belonged to age group of 20-40 years (57.5%). Mean RBS at presentation was 200.58±110.31 mg/dL. Mortality was associated with higher RBS at presentation and RBS after 12 hours. There was significant association between RBS and outcome. Increasing RBS levels had direct correlation with mean duration of Artificial Manual Breathing Unit (AMBU) ventilation, mechanical ventilation, ICU stay duration, hospital stay duration and mortality rate. Deaths in cases with RBS <150 mg/dL was 2 and in >250 mg/dL is 22. Among the study population, eight cases had glycosuria and six had ketonuria at presentation. Mean POP score was also higher among these subjects with hyperglycaemia, glycosuria and ketonuria.

Conclusion: Blood sugar levels, urine analysis for glucose and ketones are useful, simple and cheap markers for identifying the severity of OP. Their presence indicates patient was at higher risk of developing complications and patient may be planned for referral to higher centre from non equipped centres. Hyperglycaemic state is a poor prognosticating factor.

Keywords: Glycaemic status, Mechanical ventilation, Morbidity, Mortality, Prognosis

INTRODUCTION

It is roughly estimated that almost five to six people per lac population die because of poisoning. OP accounts for 4th common cause of mortality worldwide. India, being a predominantly developing country and agriculture based, the OP compounds are used almost at every place [1].

The condition of OP presents with features of excessive body secretions, drooping of eyelids, gastrointestinal symptoms, difficulty in breathing, fasciculations, tremors, convulsions and can be complicated with Acute Respiratory Distress Syndrome (ARDS) and various other symptoms. Constricted pupils and other cholinergic symptoms are clinical clue towards diagnosis of OP. Other commonly seen biochemical abnormalities associated with OP poisoning are hyperglycaemia, hyperamylasemia, hypercortisolemia, glycosuria, ketonuria and diabetic ketoacidosis [2,3]. Pseudo cholinesterase level estimation is not possible to be performed at many rural healthcare centers, thus limiting the diagnosis and also prognostication of the OP cases. There is a need for cheaper and easily available parameters. Timely diagnosis and prompt treatment helps in prevention of complications like aspiration pneumonitis, respiratory failure etc.

Multiple studies done on OP poisoning have reported biochemical changes like hyperglycaemia, ketonuria, glycosuria. They have concluded that hyperglycaemia was associated with more complications like pancreatitis, Acute Respiratory Distress Syndrome (ARDS), intermediate syndrome, prolonged hospital stay and ventilator requirement. The more the severity of the hyperglycaemia, there is early onset and prolonged duration of respiratory failure. Other reported events in different studies are cardiac arrhythmias, myocardial infarction, diabetic ketoacidosis, pancreatitis etc., [4-9].

This study aimed to estimate the prevalence of hyperglycaemia, glycosuria and ketonuria in patients with OP poisoning. Glycaemic parameters were studied for their usefulness as an alternative to Pseudo cholinesterase levels for predicting the severity. The aim was to establish an association between glycaemic status at presentation with severity of OP, predicting complications, duration of hospital stay, need for Intensive Care Unit (ICU) morbidity and mortality.

MATERIALS AND METHODS

This was a cross-sectional study done in tertiary care hospital, Karnataka Institute of Medical Sciences, Hubballi with a sample size of 120 subjects. The study was conducted from December 2017 to November 2018. Institutional Ethical Clearance was obtained on 21-11-2017 (No.KIMS/PGS/SYN/447/2018-18). An informed consent was obtained from the patients regarding all the tests that were going to be performed.

Sample size calculation: The sample size was estimated based on a study that reported the prevalence of OP to be 51% [8]. Taking 9% as absolute precision and with 95% of confidence interval the sample size was found to be 119. For the convenience purpose, sample size was rounded off to 120. Sample size=4 p^*q/d^2,

where p=prevalence, q=(1-p) and d=0.9

Inclusion criteria: All the patients who were non diabetic, aged more than 18 years were examined for clinical features of OP poisoning. HbA1c levels and Pseudo cholinesterase levels were estimated for confirmation and then included in the study.

Exclusion criteria: Patients with known or newly diagnosed diabetes with HbA1c >6.0 and patients who received dextrose containing medications from referring hospitals were excluded. Also cases who opted for Discharge Against Medical Advise (DAMA) and details of first 12 hours were not available are also excluded from the study.

Study Procedure

Laboratory investigations performed on the patients were RBS (at arrival and after 12 hours), blood urea, serum creatinine, HbA1c, urine sugar (at arrival and after 12 hours), urine ketone bodies (at arrival and after 12 hours), Pseudo cholinesterase levels, serum amylase, serum electrolytes, Human Immunodeficiency Virus (HIV) serology {after consent as per National AIDS Control Organisation (NACO) guidelines}, Hepatitis B Surface Antigen (HBsAg) and Hepatitis C Virus (HCV) serology (after consent) and chest radiograph. The sugar levels were grouped into three categories- <150 mg/dL (normoglycaemia), 150-250 mg/dL (mild hyperglycaemia), and >250 mg/dL (severe hyperglycaemia).

On arrival of the patient the blood and urine samples were collected immediately. If the patient's HbA1c levels and pseudo cholinesterase levels did not meet the inclusion criteria then the patient was excluded from study. POP Scoring system was used to assess the severity of the poisoning. The scoring includes parameters-pupil size, heart rate, respiratory rate, fasciculations, level of consciousness and seizures. The severity is graded as 0-3 being mild, 4-7 as moderate and 8-11 be severe [10].

STATISTICAL ANALYSIS

Data was analysed using Statistical Package for the Social Sciences (SPSS) version 22.0 software (IBM SPSS Statistics, Somers NY, USA). Categorical data was represented in the form of frequencies and proportions. Chi-square test was used as test of significance for qualitative data. Continuous data was represented as mean and Standard Deviation (SD). Independent t-test was used as test of significance. Analysis of Variance (ANOVA) was the test of significance to identify the mean difference between more than two groups for quantitative and qualitative data, respectively. Paired t-test is the test of significance for paired data such as before and after surgery for quantitative and qualitative data, respectively. Pearson correlation or Spearman's correlation was done to find the correlation between two quantitative variables and qualitative variables respectively. A p-value <0.05 was considered significant.

RESULTS

The study population included 62 males and 58 females, and 69 (57.5%) of population belonged to age group between 20-40 years [Table/Fig-1]. After 12 hours, 23 cases had severe hyperglycaemia and there were none in normoglycaemic state after 12 hours [Table/Fig-2].

Age (years)	Total n (%)	Male n (%)	Female n (%)
<20	18 (15.00)	10 (55.55)	8 (44.44)
20-40	69 (57.50)	35 (50.72)	34 (49.28)
>40-60	26 (21.67)	12 (46.15)	14 (53.85)
>60-80	5 (4.16%)	3 (4.54)	2 (3.38)
>80	2 (1.67)	2 (100)	0
Total	120	62	58

[Table/Fig-1]: Table showing age and gender distribution.

Overall, 77 patients recovered, 41 died and two got DAMA. The data of the DAMA cases was excluded while analysis. Mean RBS at presentation was 200.58±110.31 mg/dL and after 12 hours was 215.55±119.294 mg/dL. There was significant increase in RBS after 12 hours.

RBS		<150 mg/dL (Normal) n (%)	150 to 250 mg/dL (Mild) n (%)	>250 mg/dL (Severe) n (%)	Statistical parameters
RBS after 12 hours	<150	44 (81.5)	5 (14.3)	0	χ^2=75.378, df=4, p-value=<0.001*
	150 to 250	7 (13)	12 (34.3)	4 (14.8)	
	>250	3 (5.6)	18 (51.4)	23 (85.2)	

[Table/Fig-2]: Table showing distribution of RBS.
p-value <0.05 considered significant

RBS, urinary glucose and urinary ketones samples were collected at arrival and 12 hours after admission. The patients were not treated with dextrose, dextrose containing Intravenous (i.v.) fluids or other medications like steroids which can cause hyperglycaemia. Those patients who developed hypoglycaemia and need dextrose were excluded from the study.

There was significant difference in mean duration of mechanical ventilation, duration of ICU stay and hospital stay with respect to RBS levels [Table/Fig-3]. The duration of stay in hospital and ICU are less for severe hyperglycaemic cases because the cases had early mortality and hence the mean duration is lower than that of the mild hyperglycaemic cases. Worsening hyperglycaemia is an indicator for respiratory failure and need for mechanical ventilator. The mild hyperglycaemic cases also developed complications like aspiration, ARDS, pancreatitis, Diabetic Ketoacidosis (DKA) and intermediate syndromes and hence, had prolonged stay in ICU/hospital.

RBS	<150 mg/dL Mean±SD	150 to 250 mg/dL Mean±SD	>250 mg/dL Mean±SD	p-value (chi-square test)
RBS at presentation	110.44±19.14	203.08±21.72	365.21±81.65	<0.001*
RBS after 12 hours	129.00±70.13	248.06±82.25	346.52±96.33	<0.001*
AMBU duration (in days)	0.05±0.28	0.16±0.37	0.17±0.23	0.117
Mechanical ventilation duration (in days)	0.31±0.81	2.32±3.02	3.25±3.31	<0.001*
Stay In ICU duration (in days)	0.69±1.45	5.36±7.73	4.44±4.01	<0.001*
Stay in hospital duration (in days)	3.40±1.86	7.75±8.36	5.99±5.67	0.001*

[Table/Fig-3]: Duration of AMBU ventilation, duration of mechanical ventilation, duration of stay in ICU, duration of hospital stay in comparison with respect to RBS levels.
AMBU: Artificial manual breathing unit, p-value<0.05 considered significant

Mortality was associated with higher RBS at presentation and RBS after 12 hours compared to those who recovered [Table/Fig-4]. The cases with normoglycaemia and mild hyperglycaemia had higher recovery percentage of 53 (96.4%) and 19 (52.8%). The hyperglycaemic states were associated with higher mortality ranging from 17 (47.2%) to 22 (75.9%) [Table/Fig-5].

RBS	Recovered (79) Mean±SD	Recovered (79) Median	Death (41) Mean±SD	Death (41) Median	p-value (paired t-test)
RBS at presentation	151.47±76.45	114.00	294.32±106.61	266.00	<0.001*
RBS after 12 hours	159.17±87.13	119.00	334.24±89.95	316.00	<0.001*

[Table/Fig-4]: RBS Comparison with respect to outcome.
p-value <0.05 considered significant

RBS		<150 mg/dL (n=55) n (%)	150 to 250 mg/dL n=36) n (%)	>250 mg/dL (n=29) n (%)	Statistical parameters
Results	Recovered	53 (96.4%)	19 (52.8%)	7 (24.1%)	χ^2=47.562, df=4, p<0.001*
	Death	2 (3.6%)	17 (47.2%)	22 (75.9%)	

[Table/Fig-5]: Association between RBS at presentation and outcome.
p-value <0.05 considered significant

Patients with normoglycaemia even after 12 hours of presentation had very good prognosis and had 100% recovery when compared to hyperglycaemic states [Table/Fig-6].

RBS after 12 hours		<150 (n=49) n (%)	150 to 250 (n=21) n (%)	>250 (n=44) n (%)	Statistical parameters
Results	Recovered	49 (100.0%)	15 (71.4%)	13 (29.5%)	χ^2=61.810, df=4, p=<0.001*
	Death	0	6 (28.6%)	31 (70.5%)	

[Table/Fig-6]: Outcome distribution with respect to RBS after 12 hours levels.
As few patients died before 12 hours, the total is less than 120; p-value <0.05 considered significant

There was significant positive correlation between RBS at presentation and RBS after 12 hours, duration of mechanical ventilation, duration of ICU stay and duration of hospital stay [Table/Fig-7].

RBS		RBS at presentation	RBS after 12 hours	AMBU duration (days)	Mechanical ventilation duration (days)	Stay in ICU duration (days)	Stay in hospital duration (days)
RBS at presentation	Pearson correlation	1	0.769**	0.147	0.434**	0.300**	0.185*
	p-value		<0.001*	0.109	<0.001*	0.001*	0.043*
	N	120	116	120	120	120	120
RBS after 12 hours	Pearson correlation	0.769**	1	0.201*	0.491**	0.374**	0.234*
	p-value	0.001		0.031	<0.001*	<0.001*	0.012*
	N	116	116	116	116	116	116

[Table/Fig-7]: Correlations coefficients of RBS.
**Correlation is significant at the 0.01 level (2-tailed)
*Correlation is significant at the 0.05 level (2-tailed)

Hyperglycaemia was significantly associated with complications like pancreatitis, Diabetes Ketoacidosis (DKA), ARDS, aspiration pneumonitis, intermediate syndrome etc. POP severity score was higher in patients with severe hyperglycaemia both at presentation and after 12 hours of presentation to hospital. The scores in patients with RBS >250 mg/dL were 7.21 and 6.34 in each category, respectively [Table/Fig-8].

RBS		<150 mg/dL n (%)	150 to 250 mg/dL (n=37) n (%)	>250 mg/dL (n=29) n (%)	Statistical parameters
Complications	Absent	45 (83.3%)	12 (32.4%)	0	χ^2=57.41, df=2, p<0.001*
	Present	9 (16.7%)	25 (67.6%)	29 (100.0%)	
POP score	At presentation	1.37	4.24	7.21	
	At 12 hours	0.67	4.26	6.34	

[Table/Fig-8]: RBS levels and complications like pancreatitis, ARDS, DKA.
p-value <0.05 considered significant

With respect to glycosuria at presentation, there was no predictive value for severity of poisoning and duration of hospital stay [Table/Fig-9]. But, the mean duration of hospital stay was less for patients with glycosuria, and this is due to the fact that glycosurics had higher mortality and hence the cases faced mortality. But, the p-value was not statistically significant for the same.

Glycosuria at presentation	Absent Mean±SD	Present Mean±SD	p-value (Chi-square test)
AMBU duration (in days)	0.11±0.31	0.13±0.21	0.903
Mechanical ventilation duration (in days)	1.60±2.73	2.28±2.00	0.492
Stay in ICU duration (in days)	3.05±5.39	2.80±2.59	0.895
Stay in hospital duration (in days)	5.48±5.91	3.80±4.28	0.432

[Table/Fig-9]: Comparison of duration of AMBU, mechanical ventilation, duration of stay in ICU and duration of stay in hospital with respect to glycosuria at presentation.

With respect to glycosuria after 12 hours of presentation, there was statistically significant correlation with duration of hospital stay and ventilator support with p-value ranging from 0.009 to <0.001 as in above table [Table/Fig-10].

Glycosuria after 12 hours	Absent Mean±SD	Present Mean±SD	p-value (Chi-square test)
AMBU duration (in days)	0.09±0.34	0.15±0.22	0.308
Mechanical ventilation duration (in days)	0.74±1.65	3.57±3.39	<0.001*
Stay in ICU duration (in days)	1.71±2.71	5.91±7.65	<0.001*
Stay in hospital duration (in days)	4.53±2.96	7.52±8.94	0.009*

[Table/Fig-10]: Comparison of duration of AMBU, mechanical ventilation, duration of stay in ICU and duration of stay in hospital with respect to glycosuria after 12 hours.
p-value <0.05 considered significant

Glycosuria both at presentation to hospital and after 12 hours had direct correlation with POP severity score [Table/Fig-11]. It clearly depicts that normoglycaemics did not have any glycosuria and as hyperglycaemia was severe the glycosuria was higher and was never more than urinary glucose of 1+. Total 6 cases had ketonuria with hyperglycaemia whereas no ketonuria in normoglycaemics [Table/Fig-12].

Glycosuria		POP score N	POP score Mean±SD	p-value (chi-square test)
Glycosuria at presentation	Absent	112	3.37±3.27	<0.001*
	Present	8	7.88±2.80	
Glycosuria after 12 hours	Absent	81	1.94±2.45	<0.001*
	Present	39	6.69±2.69	

[Table/Fig-11]: POP severity score respect to glycosuria at presentation and after 12 hours.
p-value <0.05 considered significant

RBS		<150 mg/dL n (%)	150 to 250 mg/dL n (%)	>250 mg/dL n (%)	Statistical analysis
Urinary glucose at presentation	Nil	54 (100%)	35 (94.6%)	23 (79.3%)	Urinary glucose at presentation: χ^2=24.189, df=4, p<0.001* UKB presentation: χ^2=5.339, df=2, p=0.069.
	1+	0	0	6 (20.7%)	
	2+	0	2 (5.4%)	0	
	3+	0	0	0	
	4+	0	0	0	
Urinary ketones at presentation	No	54 (100%)	34 (91.9%)	26 (89.7%)	
	Yes	0 (0)	3 (8.1%)	3 (10.3%)	

[Table/Fig-12]: Urinary glucose at presentation and urinary ketones with respect to RBS.
UKB: Urine ketone body; p-value <0.05 considered significant

There was a significant difference in mean POP severity score with respect to ketonuria at presentation and after 12 hours. Mean POP severity score was high among those with ketonuria at presentation and after 12 hours [Table/Fig-13]. In this study, there was no significant difference in mean duration of AMBU, duration of mechanical ventilation, duration of ICU stay and duration of hospital stay with respect to presence or absence of ketonuria at presentation. The patients with ketonuria at presentation have lower mean value due to early mortality [Table/Fig-14].

Ketonuria		POP score N	POP score Mean±SD	p-value (Chi-square test)
Ketonuria at presentation	No	114	3.47±3.35	0.007*
	Yes	6	7.33±2.94	
Ketonuria after 12 hours	No	85	2.25±2.64	<0.001*
	Yes	35	6.39±3.12	

[Table/Fig-13]: POP severity score with respect to Ketonuria at presentation and after 12 hours.
p-value <0.05 considered significant

In the study, there was significant association with ketonuria after 12 hours with mean duration of mechanical ventilation and duration of hospital stay. Ketonuria after 12 hours had higher severity and more morbidity [Table/Fig-15].

There was significant association between glycosuria and ketonuria at presentation and after 12 hours with outcome. Mortality was high among those with glycosuria and ketonuria at presentation and after

12 hours [Table/Fig-16]. Glycosuria and ketonuria after 12 hours of presentation are poor prognosticating factors.

Ketonuria	Ketonuria at presentation		p-value (Chi-square test)
	No	Yes	
	Mean±SD	Mean±SD	
AMBU duration (days)	0.12±0.31	0.01±0.03	0.415
Mechanical ventilation duration (days)	1.63±2.73	1.97±1.78	0.759
Stay in ICU duration (days)	3.09±5.36	1.97±1.78	0.612
Stay in hospital duration (days)	5.54±5.91	1.97±1.78	0.144

[Table/Fig-14]: Comparison of duration of AMBU, mechanical ventilation, duration of stay in ICU and duration of stay in hospital with respect to Ketonuria at presentation.

Ketonuria	Ketonuria after 12 hours		p-value (Chi-square test)
	No	Yes	
	Mean±SD	Mean±SD	
AMBU duration (days)	0.10±0.33	0.13±0.23	0.642
Mechanical ventilation duration (days)	0.97±2.00	3.28±3.39	<0.001*
Stay in ICU duration (days)	2.00±3.18	5.62±7.78	0.001*
Stay in hospital duration (days)	4.63±3.31	7.54±9.03	0.013*

[Table/Fig-15]: Comparison of duration of AMBU, mechanical ventilation, duration of stay in ICU and duration of stay in hospital with respect to Ketonuria after 12 hours.
p-value <0.05 considered significant

Gycosuria and Ketonuria		Recovered	Death	DAMA	p-value (Chi-square test)
		n (%)	n (%)	n (%)	
Glycosuria at presentation	Absent	76 (67.9%)	34 (30.4%)	2 (1.8%)	0.004*
	Present	1 (12.5%)	7 (87.5%)	0	
Glycosuria after 12 hours	Absent	68 (88.3%)	7 (9.1%)	2 (2.6%)	<0.001*
	Present	9 (23.1%)	30 (76.9%)	0	
Ketonuria at presentation	No	77 (67.5%)	35 (30.7%)	2 (1.8%)	0.002*
	Yes	0	6 (100.0%)	0	
Ketonuria after 12 hours	No	67 (83.8%)	12 (15.0%)	1 (1.2%)	<0.001*
	Yes	10 (27.8%)	25 (69.4%)	1 (2.8%)	

[Table/Fig-16]: Association between outcome and glycosuria, ketonuria at presentation and after 12 hours.
p-value <0.05 considered significant

DISCUSSION

The OP forms one of the major groups of medical emergency and poisoning cases. OP is a treatable poisoning and prompt measures on time will reduce the mortality and morbidity. Pseudo cholinesterase is commonly used for confirming and prognosticating OP. However, multiples studies are done to use other cheaper and easily available biochemical parameters for prognostication and severity assessment. Some of the commonly used variables in different studies are RBS, glycosuria, ketonuria and amylase levels. [Table/Fig-17-19] compares different parameters in OP poisoning cases among various studies.

In a study on 90 individuals with OP, 36% of the cases had hyperglycaemia. Out of the hyperglycaemics 72% had ARDS, acute pancreatitis, 50% required ventilator support. higher glucose levels were found with severe poisoning [7]. Another study with 100 patients of OP poisoning demonstrated that survivors had less severe hyperglycaemia i.e., 109.10±27.32 mg/dL than to non survivors i.e., 163.83±31.75 mg/dL [5]. A Chinese study with 184 patients 11.95% cases had blood glucose >300 mg/dL and had higher frequency of respiratory failure. Delta glucose levels estimated showed significant variability among the survivors and non survivors. A 19.56% cases with acute glucose fluctuation resulted in adverse cardiac events [4]. A small study with 71 cases, 15.49% cases had developed intermediate syndrome and had mean glucose of 186.63±57.31 [12]. Yet another study with 102 cases one case had persistent glycosuria even at discharge. A study with 103 cases, glycosuria was noted in 56.41% of cases. About 20.51% of glycosurics had hyperglycaemia. Glycosuria was seen in patients with grade 2 and 3 severity of Bardin classification [13]. A case of 12-year-old was reported with OP with pseudo cholinesterase of 550 U/L. The kid had blood sugars of 299 mg/dL, glycosuria of 4+ and moderate ketonuria. Similarly, another case reported a 15-year-old girl with RBS of 336 md/dL had ketonuria and pseudo cholinesterase level of 326 U/L [14]. A study with 50 cases, out of six cases with sugar level >200 mg/dL four cases died [10].

Parameter	Present study	Moon J et al., [4]	Panda S et al., [5]	Ravi B N et al., [11]	Rao R and Raju G [12]	Raghapriya R et al., [13]	Panda S et al., [14]
Sample size	120	184	102	100	50	100	100
Mean age (years)	35.03	59.2	30	21.5	25	25.5	35
Male/Female	62/58	123/61	42/60	63/35	32/18	63/37	NA
Time interval between poison intake and reaching hospital	<6 hours	<2.5 hours	NA	NA	<3 hours	<5 hours	NA
Clinical features	Vomiting (67.5%) Diarrhoea (47.5%) Salivation (40%) Weakness (36%)	NA	Vomiting (82%) Salivation (71%) Bradypnea (68%) Lacrimation (52%)	Vomiting (94%) Salivation (90%)	Vomiting (82%) Salivation (62%) Sweating (58%) Altered sensorium (52%)	Vomiting Abdominal Pain Drowsiness Breathlessness	Vomiting (58%) Sweating (48%) Dyspnoea (42%)
Mode of poisoning	Suicidal (77%)	NA	NA	Suicide (90%)	Suicide	Suicide (83%)	NA
Mean RBS at presentation	200.58±110.31	189.9±94.4	119.3±33.7	NA	NA	NA	128.3±76.83
Mean Pseudo cholinesterase levels	2468.04±1113.91	1920.0±2676.4	2903.9±1803	NA	NA	NA	2413.6±1108.6

[Table/Fig-17]: Comparison of demographics and RBS levels of OP poisoning cases [4,5,11-14].

Parameter	Present study			Moon J et al., [4]			Panda S et al., [5]		
Mean POP score	3.77			2.0			NA		
RBS (mean)	<150	150-250	>250	<140	140-300	>300	Mean RBS of 108± 28.2	Mean RBS of 121.6±33.8	Mean RBS of 144.2±34.2
ICU stay (mean duration days)	0.69±1.45	5.36±7.73	4.44±4.01	6	8.5	17	5.4±0.5	5.9±5.04	6.8±0.4
MV support (mean duration days)	0.31±0.81	2.32±3.02	3.25±3.31	6	9.05	18.9	NA	NA	NA
Mortality (%)	3.6%	45.9%	75.9%	3.2%	18%	27.3%	NA	NA	NA
Mean serum Pseudo cholinesterase level	3139.63	2304.46	1426.21	2736	2210	1205	4049.6±2012.1	2751.8±1604.7	1164.3±1004.7

[Table/Fig-18]: Table comparing severity of poisoning, duration of hospitalisation and outcome [4,5].

Parameter	Present study	Pendkar PG et al., [6]	Moon J et al., [4]	Ravi BN et al., [11]	Rao R and Raju G [12]	Raghapriya R et al., [13]
RBS range and no. of cases	<150 mg/dL=54 150-250 mg/dL=37 >250 mg/dL=29	Mean 164 mg/dL=58 Mean 224 mg/dL=24 Mean 264 md/dL+8	140-200 mg/dL=58 200-300 mg/dL=41 >300 mg/dL=22	<140 mg/dL=64 >140 mg/dL=36	<140 mg/dL=31 140-200 mg/dL=13 > 200mg/dL=6	>150 mg/dL=52 >200 mg/dL=11
RBS range and complications	<150 mg/dL=16.7% 150-250 mg/dL=67.6% >250 mg/dL=100%	<200 mg/dL=22% >200 mg/dL=72%	140-200 mg/dL=63.8% 200-300 mg/dL=82.9% >300 mg/dL=100%	>200 mg/dL=81%	NA	NA
RBS range and dependency on mechanical ventilator	<150 mg/dL=15% 150-250 mg/dL=40% >250 mg/dL=45%	<200 mg/dL=22% >200 mg/dL=50%	140-200 mg/dL=8.5days 200-300 mg/dL=9.6 days >300 mg/dL=18.9 days	>140 mg/dL=72%	NA	>150 mg/dL=53.8% >20 mg/dL=100%
Mortality and RBS range	>150 mg/dL=32.5% 150-250 mg/dL=47.2% >250 mg/dL=75.9%	NA	140-200 mg/dL=3.4% 200-300 mg/dL=14.6% >300 mg/dL=27.3%	>140 mg/dL=33%	>200 mg/dL=66%	>150 mg/dL=9.6% >200mg/dL=63.63%

[Table/Fig-19]: Table comparing RBS ranges with complications and mortality [4,6,11-13].

Limitation(s)

More studies with larger sample size are needed to generalise the conclusion. Continuous follow-up of the RBS, urinary glucose and ketones were not done after 12 hours which would yielded more about natural course of the illness and disease.

CONCLUSION(S)

Early arrival and initiation of treatment was associated with better outcome in morbidity and mortality. Hyperglycaemia, glycosuria and ketonuria at presentation was associated with higher incidence of complications namely respiratory failure, aspiration, pulmonary oedema and ARDS, longer dependency on mechanical ventilator, prolonged ICU stay and hospital stay, higher morbidity and mortality. POP scoring system is very easy and useful clinical tool for bedside severity assessment. Hyperamylasemia and hyperglycaemia had a positive correlation and associated with higher morbidity and mortality. RBS levels, glycosuria and ketonuria had a positive correlation with mean dose of atropine and Pralidoxime (PAM) used for treatment. Hyperglycaemia, glycosuria and ketonuria after 12 hours of admission had a statistically significant positive correlation with respect to severity of poisoning, dose of antidotes required, complications, duration of ventilator dependency and ICU/hospital stay, morbidity and mortality.

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