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STUDY TO ASSESS THE ARTERIAL BLOOD GAS ANALYSIS AS A PROGNOSTIC PREDICTION TOOL IN ORGANOPHOSPHORUS COMPOUNDS POISONING PATIENTS

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Abstract

Background: Organophosphorus compounds are frequently used insecticides in agriculture. suicidal ingestion of Organophosphorus Compound has been common because it is easily accessible and widely used. Morbidity and mortality from acute Organophosphorus poisoning are attributed to respiratory failure which can be detected early by ABG. The aim of our study was to assess the Arterial blood gas analysis as a prognostic prediction tool in Organophosphorus compounds poisoning patients. **Material and Methods:** Present study was single-center, prospective, observational study, conducted in patients of age of more than 18 years, Consumption of OPC as per patient or attenders' history or as an evidence compound, Clinical features suggestive of OP poisoning. **Results:** Out of 102 patients, 27.5% had normal ABG, 22.6% had Metabolic acidosis, 18.6% had Respiratory acidosis, 28.4% had Respiratory alkalosis and 2.9% had Metabolic alkalosis. Out of 29 patients who did not require ventilatory support, 86% had normal ABG. Those who required ventilator, 37% had Respiratory alkalosis, 31.5% had Metabolic acidosis and 24.7% had Respiratory acidosis. Mean Duration of ventilator support in days was highest in Metabolic acidosis (6.3) group followed by Respiratory acidosis (4.3) and Respiratory alkalosis (4.3) and least in those with normal ABG findings (1). The difference in duration of ventilator support across the groups was statistically significant. Duration of ICU admission in days was highest in Metabolic acidosis (10.8) followed by Respiratory acidosis (8.6) and Respiratory alkalosis (8) patients. The difference in ICU stay across the groups was statistically significant. **Conclusion:** The present study highlights the importance of initial Arterial blood gas estimation performed on patients presenting with OP poisoning as an effective tool in the quick assessment of prognosis.

Keywords: Arterial blood gas analysis, OP poisoning, acid base disturbances, respiratory acidosis, metabolic acidosis

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 08, 2024

Introduction

Organophosphorus compounds are most commonly used pesticides in India. OP Compounds poisoning is common cause of poisoning in India.[1] OP Compounds poisoning is an important clinical problem in the rural regions of developing countries due to easy availability and less awareness among farmers. Farmers are at high risk for accidental exposure. but suicidal intent is more common than accidental exposure.[2]

Most of OP compounds are lipophilic very well absorbed from the gastrointestinal tract, lungs, skin, mucous membrane and conjunctiva on ingestion, inhalation or topical contact. Peak levels of most OP insecticides measure around 6 h after oral ingestion in man.[3,4] Exposure to Organophosphorus vapours rapidly causes upper airway irritation and bronchospasm followed by systemic symptoms. Acute respiratory failure is the most common cause of death in Organophosphorus poisoning due to increased secretions and inadequate ventilation. One of the causes of complications is an acid- base imbalance. Subsequent measures must be carried out by recognizing and correcting the acid-base disturbance at the earliest possible time.[5,6]

Evaluation of acid-base status in the OPC poisoning patients plays a critical role as early recognition of acid-base disturbance can alter the management and prognosis. Moreover, it is also very essential to determine the respiratory failure following which endotracheal intubation and, mechanical ventilation can be done.[7] The aim of our study was to assess the Arterial blood gas analysis as a prognostic prediction tool in Organophosphorus compounds poisoning patients.

Material And Methods

Present study was single-center, prospective, observational study, conducted in department of medicine, KIMS hospital, Hubli, India. Study duration was of 2 year (November 2020 to October 2022). Study approval was obtained from institutional ethical committee.

Inclusion criteria

- All Age of more than 18 years, Consumption of OPC as per patient or attenders' history or as an evidence compound, Clinical features suggestive of OP poisoning, Participants who give written and informed consent

Exclusion criteria

- Any mixed compound poisoning
- Age < 18 years
- Time of consumption more than 24 Hours
- Comorbidities such as chronic kidney disease, chronic obstructive pulmonary disease, congestive heart failure, and chronic lung disease

Study was explained to patients in local language & written consent was taken for participation & study. Investigations such as complete hemogram with peripheral smear study, random blood sugar, liver function tests, renal function test, arterial blood gas analysis, serum pseudocholinesterase levels, serum electrolytes, urine routine test, ECG & Chest X Ray were done in the selected patients. POP score calculated and patients were investigated for ABG analysis. Severity and prognosis of patients accessed using ABG analysis.

Data were entered into Microsoft Excel and statistical analysis was carried out in SPSS software version 17.0. Qualitative variables like age categories, gender, occupation, tobacco and alcohol were presented as frequency and percentages. Duration between poison consumption and time of presentation, poison compound POP on day 1 and two were reported as percentages. Quantitative variables like ABG, ABG HCO3, ABG PCO2, serum potassium atropinisation dose, duration of hospital +day, duration of ICU stay and duration of

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ventilator support were expressed as mean with standard deviation. Ventilator support, complications during ventilator support and outcome were reported as proportions. Bar diagram and pie charts were used for graphical representation of data.

Comparison of ABG and POP score day-1, ventilator support was done with chi square test. Comparison of poison compound with ventilator support and outcome was done using chi squared teat. Comparison of ABG and duration of hospital stay, ICU stay and duration of ventilator support was done using one-way ANOVA. A p value of less than 0.05 was considered as statistically significant.

Results

A total of 102 patients were included in the study. 45% were in the age group of 21-30 years followed by 30% in 31–40-year age group and 12% in 41-50 age group. There ten patients in the age group of 18-20 years. 67% of the patients were men and rest 33% were women. 63% of the patients were engaged in agriculture and related occupation. Out of total 102 patients, 73% did not report using tobacco or alcohol. Tobacco use was reported by 10 patients and 18 patients (17.7%) reported consumption of alcohol. Of total, 62% reached hospital after 4-8 hours from the time of consumption of poison. Only 27% reached before 4 hours. Twelve patients reached hospital during 8-12 hours.

Table 1: General characteristics

Characteristics	**Number**	**Percentage**
Age groups (years)		
18-20	10	9.8
21-30	46	45.1
31-40	31	30.4
41-50	12	11.8
51-60	3	2.9
Gender		
Male	68	66.7
Female	34	33.3
Occupation		
Agricultural	64	62.8
Non-agricultural	38	37.3
Tobacco and alcohol **addiction**		
None	74	72.6
Tobacco	10	9.8
Alcohol	18	17.7
Duration		
<4 HOURS	27	26.5
4-8HOURS	63	61.8
8-12 HOURS	12	11.8

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 08, 2024

Profenophos was the most consumed poison, followed by Chlorpyriphos by 25 patients and Monocrotophos by 18 patients. Dichlorvos, Dimethoate and Malathion were consumed by 11, 9 and 7 patients respectively.

Table 2: Poison compound consumed

Compound	Number	Percentage
Profenophos	32	31.4
Chlorpyriphos	25	24.5
Monocrotophos	18	17.7
Dichlorvos	11	10.8
Dimethoate	9	8.8
Malathion	7	6.9

On Day-1, as per POP score, 34 were in mild stage, 39 in moderate stage and 29 were in severe stage. On Day-2, as per POP score, 34 were in mild stage, 42 in moderate stage and 26 were in severe stage.

Table 3: POP score on Day 1

POP score	on Day 1		on Day 2	
	Number	Percentage	Number	Percentage
Mild	34	33.3	34	33.3
Moderate	39	38.2	42	41.2
Severe	29	28.4	26	25.5

Average hospital stay and ICU stay was 10.5 and 7.7 days respectively. Of 73 patients who required ventilator support, the average ventilator days was 4.8 days.

Table 4: Hospital stay, ICU stay and duration on mechanical ventilation

Parameter (in days)	Mean	SD	Median	Minimum	Maximum
Duration of hospital stay	10.5	4.2	9	4	28
Duration of ICU stay	7.7	3.6	7	3	21
Duration of ventilator support (n=73)	4.8	2.9	4	1	14

Of total 102 patients, 28 had normal ABG, 23 had Metabolic acidosis, 19 had Respiratory acidosis, 29 had Respiratory alkalosis and rest three of them had Metabolic alkalosis.

Table 5: ABG interpretation

ABG interpretation	Number	Percentage
Normal	28	27.5
Metabolic acidosis	23	22.6
Respiratory acidosis	19	18.6
Metabolic alkalosis	3	2.9
Respiratory alkalosis	29	28.4
Total	102	100.0

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 08, 2024

The association between ABG findings and POP categories was statistically significant (P<0.001). in POP-Mild group, 73.5% had normal ABG compared to only 3.4% in the POP-severe group. 51% in the POP-severe group had Metabolic acidosis. 46.2% in the POP-Moderate group had Respiratory alkalosis and 21% had Respiratory acidosis. 27.6% in the POP-severe group had Respiratory alkalosis.

Table 6: Comparison of ABG and POP Score (Day-1)

ABG	POP-Mild		POP-Moderate		POP-Severe	
	N	%	n	%	N	%
Normal	25	73.5	2	5.1	1	3.4
Metabolic acidosis	1	2.9	7	17.9	15	51.7
Respiratory acidosis	3	8.8	12	30.8	4	13.8
Metabolic alkalosis	2	5.9	0	0.0	1	3.4
Respiratory alkalosis	3	8.8	18	46.2	8	27.6
Total	34	100.0	39	100.0	29	100.0
Chi square p value<0.001 (Significant)						

73 patients required ventilator support and 29 did not required mechanical ventilator. Out of 29 patients who did not require ventilatory support, 86% had normal ABG findings. In those who required ventilatory support, 37% had Respiratory alkalosis, 31.5% had Metabolic acidosis and 24.7% had Respiratory acidosis. These differences were statistically significant (P<0.001).

Table 7: Comparison of ABG and Ventilatory support

ABG	**Ventilation-Yes**		**Ventilation-No**	
	N	**%**	**N**	**%**
Normal	3	4.1	25	86.2
Metabolic acidosis	23	31.5	0	0.0
Respiratory acidosis	18	24.7	1	3.4
Metabolic alkalosis	2	2.7	1	3.4
Respiratory alkalosis	27	37.0	2	6.9
Total	73	100.0	29	100.0
Chi square p value<0.001 (Significant)				

In patients who consumed Chlorpyriphos, 80% required ventilatory support and in Monocrotophos, 94.4% required ventilatory support followed by 68.8% in Profenophos and 63.6% in Dichlorvos. These differences are statistically significant (P=0.034).

Table 8: Comparison of compound and Ventilatory support

Compound	**Ventilator support -Yes**		**Ventilator support -No**	
	N	**%**	**n**	**%**
Chlorpyriphos	20	80.0	5	20.0
Dichlorvos	7	63.6	4	36.4
Dimethoate	4	44.4	5	55.6
Malathion	3	42.9	4	57.1
Monocrotophos	17	94.4	1	5.6
Profenophos	22	68.8	10	31.3
Total	73	71.6	29	28.4
Chi square p value=0.034 (Significant)				

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 08, 2024

Out of 102 patients, 8 patients died and rest 94 were discharged. In total there were 8 deaths, 3 in Chlorpyriphos, 3 in Profenophos poisoning and two in Monocrotophos poisoning.

Table 9: Comparison of compound and outcome

Compound	**Death**		**Discharge**	
	N	**%**	**N**	**%**
Chlorpyriphos	3	37.5	22	23.4
Dichlorvos	0	0.0	11	11.7
Dimethoate	0	0.0	9	9.6
Malathion	0	0.0	7	7.4
Monocrotophos	2	25.0	16	17.0
Profenophos	3	37.5	29	30.9
Total	8	100.0	94	100.0
Chi square p value=0.659 (Not significant)				

Duration of hospital stay was highest in Metabolic acidosis group followed by Respiratory acidosis and Respiratory alkalosis patients. The hospital stay was least in those with normal ABG findings (7 days). The difference in hospital stay across the groups was statistically significant.

Duration of ICU admission was highest in Metabolic acidosis group followed by Respiratory acidosis and Respiratory alkalosis patients. The ICU admission in days was least in those with normal ABG findings (4.4 days). The difference in ICU stay across the groups was statistically significant.

Duration of ventilator support in days was highest in Metabolic acidosis group followed by Respiratory acidosis and Respiratory alkalosis patients. The duration of ventilator support was least in those with normal ABG findings (mean of 1 day). The difference in duration of ventilator support across the groups was statistically significant.

Table 10: Comparison of ABG and duration of hospital stay

ABG	**Duration of hospital stay**	**Duration of ICU stay**	**Duration of ventilator support**
	Mean ± SD	**Mean ± SD**	**Mean ± SD**
Normal	7 ± 0.3	4.4 ± 0.6	1 ± 0
Metabolic acidosis	13.9 ± 5.6	10.8 ± 4	6.3 ± 2.8
Respiratory acidosis	11.6 ± 3	8.6 ± 2.7	4.3 ± 2.9
Metabolic alkalosis	8.3 ± 1.2	6 ± 1	2.5 ± 0.7
Respiratory alkalosis	10.8 ± 2.9	8 ± 3	4.3 ± 2.7
P value	<0.001 (Significant)	<0.001 (Significant)	0.005 (Significant)

Out of 32 patients who had intermediate syndrome53.1% had Metabolic acidosis and 34% Respiratory alkalosis. In those 70 patients who did not develop intermediate syndrome, 40% had normal ABG findings, 25.7% had Respiratory alkalosis and 21.4% had Respiratory acidosis. These differences were statistically significant (P<0.001).

Table 11: Comparison of ABG and intermediate syndrome

ABG	**Intermediate syndrome - Yes**		**Intermediate syndrome - No**	
	N	**%**	**N**	**%**
Normal	0	0.0	28	40.0
Metabolic acidosis	17	53.1	6	8.6
Respiratory acidosis	4	12.5	15	21.4

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 08, 2024

Metabolic alkalosis	0	0.0	3	4.3
Respiratory alkalosis	11	34.4	18	25.7
Total	32	100.0	70	100.0
Chi square p value<0.001 (Significant)				

Out of 102 patients, 13 developed VAP complications. In those who developed VAP complications, 46.2% had Metabolic acidosis, 38.5% had Respiratory alkalosis, followed by 15.4% in Respiratory acidosis patients. In those who did not develop VAP complications, 31.5% had normal ABG followed by 27% in Respiratory alkalosis and 19.1% each in Metabolic acidosis and Respiratory acidosis respectively. This difference was not statistically significant.

Table 12: Comparison of ABG and complications

ABG	**VAP -Yes**		**VAP -No**	
	N	**%**	**N**	**%**
Normal	0	0.0	28	31.5
Metabolic acidosis	6	46.2	17	19.1
Respiratory acidosis	2	15.4	17	19.1
Metabolic alkalosis	0	0.0	3	3.4
Respiratory alkalosis	5	38.5	24	27.0
Total	13	100.0	89	100.0
Chi square p value=0.066(Not significant)				

Discussion

OPC poisoning in India is a common medical emergency and most common poisoning seen in south Indian states. Because easily available for self-harm and accidental exposures are also common. In our study many patients presented with features of vomiting and excessive salivation. Examination had showed pinpoint pupils, increased secretions, bradycardia, drowsiness, and respiratory abnormalities like low saturation, tachypnoea and crepitations on auscultation.

Present study is prospective observational study with sample size of 102 patients. Conducted in KIMS Hubballi to study the correlation of ABG analysis in predicting the outcome of OPC poisoning patients. The results were analysed and compared with similar studies.

The sample size in various studies is 100 and above except for study by Anjali Pergulwar *et al.*,[8] Jiung-Hsiun Liu *et al.*,[9] and Eun-Jung Kang *et al.*,[10] which had 50,82 and 68 respectively because duration of study is less in these three. The mean age of the study population is around 30-35 years age group except for study in Jiung-Hsiun Liu *et al.*,[9] and Eun-Jung Kang *et al.*,[10] where mean age is 53.8 and 54.4 which is higher than other studies. This is because the study population of Jiung-Hsiun Liu *et al.* is from China and Eun-Jung Kang *et al.* is from Korea. whereas others are Indian studies. The changes in demography, working age group population and financial status differs in these countries.

The time interval was less in Nam-Jun Cho *et al.*,[11] i.e. 2.97 hours on an average because of the better transport and referral system in China. Other Indian studies[8] also had an average of 3-6 hours of presentation. Severe POP score is more in our study compare to other studies because time interval between poison intake and reaching hospital is more in our study.

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 08, 2024

Table 13: Comparison of POP score in different studies

POP score	Present study	Devee Anjana *et al.*,[12]	Dr.Subhash L.Patil *et al.*,[13]	Gunosindhu Paul *et al.*,[14]
Mild	33.3	44.54	70	56.7
Moderate	38.2	47.28	26.7	34.7
Severe	28.4	8.18	3.3	8.6

Mean pseudocholinesterase levels are less in Eun-Jung Kang *et al.* Study because they have taken more serious patients in their study. in remaining studies Mean pseudocholinesterase levels are between 900-1800 U/L.

Table 14: Comparison of Mean pseudocholinesterase levels in different studies

	Present study	Anjali Pergulwar *et al.*,[8]	Jiung-Hsiun Liu *et al.*,[9]	Eun-Jung Kang *et al.*,[10]	Tanveer Hassan Banday *et al.*,[15]
Mean pseudocholinesterase levels (U/L)	1322.3	1756.4	1459.2	209	905

Mean ABG parameters in all studies are almost comparable.

Table 15: Comparison of Mean ABG parameters in different studies

	Present study	Jiung-Hsiun Liu *et al.*,[9]	Eun-Jung Kang *et al.*,[10]
Ph	7.4	7.27	7.35
HCO_3 (mmol/L)	21.9	18.6	18.75
PCO_2 (mmhg)	37.7	36.2	36.2

Respiratory alkalosis is common acid-base disturbance in all studies except Jiung-Hsiun Liu *et al.*,[9] where metabolic acidosis is common (39.05%). Next common is metabolic acidosis except for studies in Anjali Pergulwar *et al.*,[9] and Sandhyapogu Lakshmi Bai *et al.*,[16] least acid-base disturbance seen in all studies is metabolic alkalosis.

Number of patients requiring ventilator is more in our study (71.6) because more patients in our study developed respiratory failure and we have taken more severe POP score patients. Dr.Subhash L.Patil *et al.*,[13] study has least number of patients on ventilator (26.6) because they included more mild POP score patients.

Deaths were more in Tanveer Hassan Banday *et al.*,[15] and Jiung-Hsiun Liu *et al.*,[9] studies 33.3% and 26.82% respectively. Least deaths seen in S Subikshavarthni *et al.*,[17] (6%). deaths in our study are 7.8%. Mortality is more in metabolic acidosis group in all studies except S Subikshavarthni *et al.*,[17] study where respiratory acidosis group has more mortality.

POP score corelates with plasma pseudocholinesterase levels, ABG analysis, requirement of ventilator support, duration of ventilator support, duration of ICU stay, atropinisation dose and complications. Majority of the patients with mild POP score has normal ABG findings whereas moderate and severe POP score group has more acid-base disturbances more common being respiratory alkalosis and metabolic acidosis next is respiratory acidosis. Ventilator requirement, duration of ICU stay, atropinisation dose and complications are more as POP score increases.

The early arrival and initiation of treatment was associated with better outcome in morbidity and mortality of OPC poisoning patients. Neck muscle weakness, convulsions, generalized fasciculations were associated with higher severity of poisoning. Peradeniya Organophosphorus Poisoning scale is a much-needed clinical assessment scale for

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 08, 2024

categorising the severity of cases with acute organophosphorus poisoning. Majority had respiratory Alkalosis (29) probably due to decrease respiratory drive, respiratory paralysis leading to decreased partial pressure of oxygen in blood due to poor diffusion across the alveoli.

Limitations of present study were, smaller sample size, single center study & continuous follow up of the ABG not done.

The present study highlights the importance of initial ABG performed on patients presenting with OP poisoning as an effective tool in the quick assessment of prognosis. Special consideration should be given to patients presenting with metabolic acidosis and respiratory acidosis as it is concluded from this study that acidosis (mainly metabolic acidosis) is associated with increased morbidity and mortality. As a result, the treatment can be intensified and implemented quickly without any delay

Conclusion

The present study highlights the importance of initial ABG performed on patients presenting with OP poisoning as an effective tool in the quick assessment of prognosis. Arterial blood gas estimation has to be done to interpret the acid base disturbances and treat accordingly and as soon as possible. Since respiratory acidosis as well as alkalosis can be managed by mechanical ventilation and metabolic acidosis can be treated with bicarbonate. by which we can reduce mortality and morbidity of OPC poisoning.

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