PROGNOSTIC SIGNIFICANCE OF ACID BASE DISTURBANCES AMONG PATIENTS WITH ACUTE ALUMINUM PHOSPHIDE POISONING

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ABSTRACT

Background: Aluminum phosphide (ALP) is used to protect stored grains from rodents & pests. ALP poisoning is considered one of the significant public health problems which could occur accidentally, suicidal, or even occupational. The main presentations of acute ALP poisoning are gastrointestinal symptoms, profound circulatory collapse, arrhythmia, and electrolyte & acid-base disturbances. **Objectives:** The current study evaluated acid-base disturbances on admission as a simple outcome predictor in acute ALP poisoned patients. **Patients & methods:** 100 adult patients with acute ALP poisoning were included in this study. Patients with cardiovascular, chronic renal and liver diseases were excluded. Additionally, patients admitted with mixed intoxication or associated trauma and those who received any medications before admission were excluded from this study. Arterial blood gases (ABG) were done and analyzed to all included patients on admission before receiving any medications. **Results:** There was a significant positive correlation between pH value and pre-hospitalization period, systolic blood pressure (SBP), diastolic blood pressure (DBP), and period of hospital stay. A significant negative correlation existed between pH and dose of ALP, respiratory rate, and dose of required vasopressor. Bicarbonate level (HCO_3) registered a significant positive correlation with SBP and DBP. Meanwhile, a significant negative correlation existed between HCO_3 and both respiratory rate and dose of required vasopressor. There was a significant difference between survivors and non-survivors regarding pH, HCO_3, $PaCO_2$, and PaO_2. Furthermore, there was a significant difference between patients who required and did not require mechanical ventilation considering pH, HCO_3, and PaO_2. **Conclusion:** It could be concluded that determining acid-base disturbance on admission in acute ALP poisoned patients is a simple, cheap, and reliable marker that may help to predict mortality and mechanical ventilation requirement.

Keywords: Acute aluminum phosphide (ALP) poisoning, pH, HCO_3, $PaCO_2$ and PaO_2, Ventilation, Mortality.

INTRODUCTION

Aluminum phosphide (ALP) protects stored grains from rodents & pests **(Farzaneh et al., 2018).** ALP poisoning is considered one of the significant health problems which could occur accidentally, suicidal, or even occupational **(Ahmadi et al., 2018).** Easy availability and low price make it one of the most used suicidal poisons, especially Egypt **(Saleh &Makhlof, 2018).**

Acute ALP poisoning is due to ingestion, inhalation, or even absorption through the skin **(Gurjar et al., 2011).** Several mechanisms have been described for phosphides toxicity. Inhibition of cytochrome C, oxidative stress, heart failure, and insufficiency of blood vessels integrity are the most common mechanisms addressed **(Mehrpour et al., 2019).**

According to **Bumbrah et al. (2012),** cytotoxic phosphine gas generated from acid hydrolysis of ALP affects the heart, lungs, gastrointestinal tract (GIT), and kidneys. The main presentations of acute ALP poisoning include GIT symptoms, arrhythmia, profound circulatory collapse, electrolyte, and acid-base disturbances **(Sheta et al., 2019).**

Expecting consequences in severely intoxicated patients is the main goal for any toxicologist in different health care systems. At the same time, acute ALP toxicity stills a big problem with significant outcome events, together with the conspicuous shortage of recent Egyptian research discussing acid-base disturbances as a predictor of acute ALP poisoning. Hereafter, the current study aimed to use acid-base disturbance as a simple, inexpensive tool to predict mortality and significant outcome events in acute ALP poisonings.

PATIENTS AND METHODS

This study is a prospective cross-sectional study. It was conducted following approval of the medical research ethics committee of the Tanta Faculty of Medicine. Acute aluminum phosphide (ALP) intoxicated patients admitted to Tanta Poison Control Center, Tanta Emergency University Hospital throughout the period from 1st of November 2020 to 31st of May 2021 were included in this study.

After receiving detailed information about the study, all patients or their guardians were asked to provide informed written consent for participation. Data confidentiality, including results of investigations, were maintained by making code numbers for all included patients (available for primary investigator only), data were analyzed anonymously.

Adult patients acutely exposed to aluminum phosphide were included in this study. Patients with cardiovascular, chronic renal and liver diseases were excluded. Additionally, patients admitted with mixed intoxication or associated trauma and those who received any medications before admission were excluded from this study.

Diagnosis of acute ALP poisoning was based on the history of exposure, typical clinical manifestations, and reliable identification of the compound using containers brought by patients' attendants. Confirmation was done using the silver nitrate test for the detection of phosphine in stomach contents.

Demographic data (including age, gender, residence, and occupation) and toxicological data (including the manner of poisoning, pre-hospitalization period, amount of ALP, and route of exposure) were reported for all included cases.

Arterial blood gases were analyzed from 1 ml of arterial blood samples under complete aseptic conditions. The samples were withdrawn in heparinized tubes on admission before administrating any medication.

Blood pH, bicarbonate level (HCO_3), partial arterial carbon dioxide pressure ($PaCO_2$), and partial arterial oxygen pressure (PaO_2) was measured using an ion-selective electrode (Rapid lab 855, Bayer Company, USA) according to **Kokholm (1990)**. Blood collection syringes, tubes, and body fluids (blood samples) were safely disposed of to avoid any risk of environmental pollution and infection control.

Statistical analysis

Statistical analysis and data presentation were conducted using SPSS (Statistical Package for the Social Sciences) version 22 computer program. All numerical variables were checked for normality by the Shapiro Wilk test. Numerical variables with normal distribution were presented as mean ±SD, while those with abnormal distribution were expressed as the median and interquartile range (25th - 75th percentile).

Differences between two groups having normally distributed data were tested using Independent T-test.

Categorical variables were summarized as frequencies and percentages, and the association between different variables was tested using X^2 tests (Pearson's Chi-square for independence or Fisher Exact Tests as appropriate).

Spearman's Rank correlations were done between arterial blood gases and some demographic, toxicological, and clinical data. Furthermore, Receiver operating characteristics (ROC) curve analysis was carried out to test the discrimination power of the studied arterial blood gases to predict mortality and the need for mechanical ventilation. Areas under the ROC curves, sensitivity, and specificity were calculated. Significance was adopted at $p < 0.05$ to interpret the results of tests **(DeLong et al., 1988** and **Schober et al., 2018).**

RESULTS

During the study period, 100 patients presented with acute ALP poisoning have fulfilled eligibility criteria. The median age of included patients was 20 years. Females represented 58%, rural residences accounted for 87%. Socio-demographic characteristics of participant patients are demonstrated in **the table (1).**

Tables (2&3) illustrate toxicological, clinical data, and ABG results of studied patients. Both suicidal manners of poisoning and ingestion route of poisoning registered 97% of cases. Median values of both systolic and diastolic blood pressure were 80 and 50 mmHg, respectively. The mean value of pH was7.32 ± 0.1; bicarbonate (HCO3) registered a mean value of 14.4 ± 5.3.

Table (4) demonstrates patients' clinical course and outcome, the median dose of vasopressor was 16.6 mg. The period of hospital stay ranged between 3-144 hours with a median value of 17 hours. Mechanical ventilation was required in 47 patients. Finally, forty-one patients were improved and discharged; meanwhile, 59 ended up with death.

Spearman's rank-order correlation shows that blood pH value had a significant positive correlation with a pre-hospitalization period, SBP, DBP, and period of hospital stay. Inversely, a significant negative correlation existed between blood pH and each ALP dose, respiratory rate, and dose of required vasopressor. Regarding bicarbonate level (HCO_3), a significant positive correlation between SBP and DBP was registered. Meanwhile, a significant negative correlation existed between HCO_3 and both respiratory rate and dose of required vasopressor **(Table 5).**

A significant positive correlation could be detected between $PaCO_2$ and each SBP, DBP, and period of hospital stay. Contrariwise, a significant negative correlation existed between $PaCO_2$ and respiratory rate. The PaO_2 had a significant positive correlation with a pre-hospitalization period, SBP, DBP, and period of hospital stay. While a significant negative correlation existed between PaO_2 and both doses of ALP and respiratory rate, as noticed in **table (5).**

Table (6) reveals a significant difference between survivors and non-survivors regarding pH, HCO_3, $PaCO_2$, and PaO_2. Furthermore, there was a significant difference between patients who required and did not require mechanical ventilation considering pH, HCO_3, and PaO_2.

Table (7) and **figure (1)** show the results of the analysis of the receiver operating characteristics (ROC) curve of pH as a predictor of mortality in ALP poisoned patients. Blood pH level had an area under the curve (AUC) of 0.776, graded as fair AUC. The optimal cut-off value of pH was identified as ≤7.33, where the pH value had a sensitivity of 77.97 and specificity of 72.5 for mortality prediction.

Analysis of the ROC curve of HCO_3 as a predictor of mortality in ALP poisoned patients reveal that the HCO_3 level had a fair area under the curve (0.702). The optimal cut off value of HCO_3 was identified as ≤12.6, where HCO_3 level had a sensitivity of 59.32 and specificity of

75.61 for prediction of mortality **(Table 7 & figure 1)**

ROC curve of $PaCO_2$ in ALP poisoned patients poorly predicts mortality (AUC 0.623) at a cut-off value of ≤27 with a sensitivity of 67.8 and specificity of 56.1. Meanwhile, the ROC curve of PaO_2 in acute ALP poisoned patients was a good predictor of mortality (AUC 0.816) at a cut-off value of ≤87.6 with a sensitivity of 76.27 and specificity of 78.05 **(Table 7 & figure 1)**.

Table (8) and **figure (2)** demonstrate that pH and PaO_2 somewhat predict the need for mechanical ventilation in acute ALP poisoned patients (AUC 0.747 and 0.701 respectively) with a sensitivity of 82.98 and 53.19 and specificity of 63.46 and 83.02, respectively. HCO3 and PaCO2 poorly predict the need for mechanical ventilation in acute ALP poisoned patients (AUC 0.676 and 0.572, respectively) with a sensitivity of 61.70 and 21.28 and specificity of 69.81 and 94.34, respectively.

Table (1): Socio-demographic data of aluminum phosphide poisoned patients (N=100)

Age				**Gender**				**Residence**			
Min.	Max.	Median	IQR	Male		Female		Urban		Rural	
				N.	%	N.	%	N.	%	N.	%
16.0	53.0	20.0	18.0-25.5	42	42%	58	58%	13	13%	87	87%

Occupation					
Employed		Unemployed		Student	
N.	%	N.	%	N.	%
25	25%	35	35%	40	40%

N: number, Min: minimum, Max: maximum, IQR: Interquartile range

Table (2): Toxicological data of aluminum phosphide poisoned patients (N=100)

Toxicological data										
Manner of poisoning				**Pre-hospitalization period (hours)**			**Route of poisoning**			
Accidental		Suicidal		Range	Median	IQR	Ingestion		Inhalation	
N.	%	N.	%				N.	%	N.	%
3	3%	97	97%	0.5 -14	2	1.5- 4	97	97%	3	3%

Amount of poison (Number of ALP tablets)											
0.25 tablet		0.5 tablet		1 tablet		1.5 tablet		2 tablets		3 tablets	
N.	%	N.	%	N.	%	N.	%	N.	%	N.	%
12	12%	23	23%	55	55%	2	2%	7	2%	1	1%

N: number, IQR: Interquartile range.

Table (3): Clinical and laboratory data of aluminum phosphide poisoned patients (N=100)

Clinical data											
SBP (mmHg)			**DBP** (mmHg)			**Pulse** (beat/minute)			**R.R** (cycle/minute)		
Range	Median	IQR	Range	Median	IQR	Range	Median	IQR	Range	Median	IQR
50 - 130	80	60-90	30 - 80	50	40-60	60 - 190	103	89-116.5	16 - 44	26	21-30

Arterial blood gases results									
pH		**HCO3** (mEq/L)		**PaCO2** (mmHg)			**PaO2** (mmHg)		
Range	Mean ± SD	Range	Mean ± SD	Range	Median	IQR	Range	Median	IQR
7.09 - 7.51	7.32 ± 0.10	4 - 28	14.4 ± 5.3	10 - 44	25	20-36.1	40.0 - 99.3	86.5	69.5-91.5

IQR: Interquartile range, SBP: Systolic Blood Pressure DBP: Diastolic Blood Pressure, R.R: respiratory rate, mmHg: millimeter mercury, mEq/L: milliequivalent per liter, SD: standard deviation.

Table (4): Clinical course and outcome of aluminum phosphide poisoned patients (N=100)

Clinical course and Outcome							
Dose of required vasopressors (mg)				**Period of hospital stay** (hours)			
Min.	Max.	Median	IQR	Min.	Max.	Median	IQR
2.5	68.9	16.6	8.3-23	3	144	17.0	9 – 48
Improved & discharged		**Mechanical ventilation**		**Mortality**			
N.	%	N.	%	N.	%		
41	41%	47	47%	59	59%		

N: number, Min: minimum, Max: maximum, IQR: Interquartile range, mg. milligram.

Table (5): Associations between the arterial blood gases and some toxicological and clinical data

		pH	**HCO3** (mEq/L)	**PaCO2** (mmHg)	**PaO2** (mmHg)
Dose (tablets)	Rs P value	-0.234 0.020*	-0.045 0.657	-0.018 0.862	-0.250 0.012*
Prehospitalization Period (h)	Rs P value	0.248 0.014*	0.165 0.103	0.096 0.343	0.232 0.021*
SBP (mmHg)	Rs P value	0.429 <0.001*	0.462 <0.001*	0.285 0.004*	0.319 0.001*
DBP (mmHg)	Rs P value	0.374 <0.001*	0.452 <0.001*	0.282 0.004*	0.273 0.006*
Pulse (beat/minute)	Rs P-value	-0.136 0.178	-0.187 0.063	-0.039 0.699	-0.079 0.436
RR (cycle/minute)	Rs P value	-0.248 0.013*	-0.571 <0.001*	-0.690 <0.001*	-0.379 <0.001*
Dose of required vasopressors (mg)	Rs P value	-0.299 0.023*	-0.318 0.001*	-0.10 0.322	0.019 0.853
Period of hospital stay (h)	Rs P-value	0.320 0.001*	0.195 0.052	0.199 0.047*	0.579 <0.001*

***significant at p<0.05 - SBP: Systolic Blood Pressure DBP: Diastolic Blood Pressure, R.R: respiratory rate, mmHg: millimeter mercury, mEq/L: milliequivalent per liter, Rs: correlation coefficient of Spearman's Rank correlation**

Table (6): Comparison of arterial blood gases between survivors and non-survivors and between patients requiring mechanical ventilation versus non-ventilated patients.

		Mortality			**Need for MV**		
		N.	**yes**	**P-value**	**N.**	**Yes**	**P-value**
pH	**Range** **Mean ± SD**	7.14 - 7.51 7.37 ± 0.09	7.09 - 7.47 7.28 ± 0.09	<0.001*	7.14 - 7.51 7.36 ± 0.09	7.09 - 7.47 7.27 ± 0.09	<0.001*
HCO3 (mEq/L)	**Range** **Mean ± SD**	6.6 - 28.0 16.6 ± 5.1	4.0 - 23.0 12.9 ± 4.9	<0.001*	6.6 - 28.0 15.9 ± 5.2	4.0 - 23.0 12.7 ± 5.0	0.002*
PaCO2 (mmHg)	**Range** **Mean ± SD**	14.8 - 43.0 29.6 ± 8.5	10.0 - 44.0 25.7 ± 9.4	0.037*	14.8 - 44.0 28.5 ± 9.0	10.0 - 44.0 26.0 ± 9.3	0.171
PaO2 (mmHg)	**Range** **Median (IQR)** **Mean rank**	53.0 - 99.0 90.0 (88.9-95.0) 69.17	40.0 - 99.3 75.0 (62.0-87.6) 37.53	<0.001*	40.0 - 99.0 88.0 (83.0-93.5) 59.92	42.0 - 99.3 75.0 (62.0-88.0) 39.87	0.001*

MV: mechanical ventilation*significant at p<0.05, IQR: Interquartile range, SD: standard deviation, mmHg: millimeter mercury, mEq/L: milliequivalent per liter.

Table (7): Diagnostic performance of the arterial blood gases in prediction mortality by receiver operating characteristic (ROC) curve analysis

Mortality						
Predictor	**Cut off**	**Sensitivity %**	**Specificity %**	**AUC**	**95% CI**	**P-value**
pH	≤7.33	77.97	72.50	0.776	0.681 to 0.854	<0.001*
HCO3 (mEq/L)	≤12.6	59.32	75.61	0.702	0.603 to 0.790	0.001*
$PaCO_2$ (mmHg)	≤27	67.80	56.10	0.623	0.520 to 0.718	0.029*
PaO2 (mmHg)	≤87.6	76.27	78.05	0.816	0.727 to 0.887	<0.001*

***significant at p<0.05, AUC: area under the curve, CI: confidence interval, mmHg: millimeter mercury, mEq/L: milliequivalent per liter.**

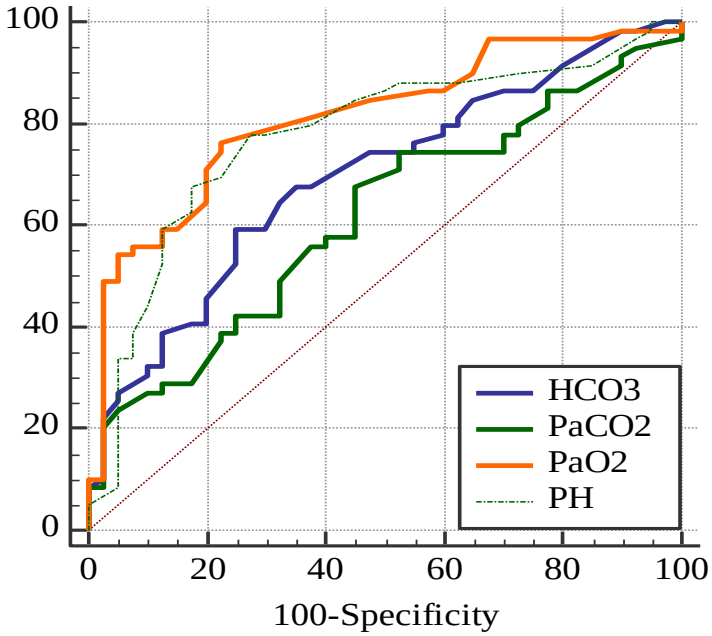

Figure (1): Diagnostic performance of the arterial blood gases in prediction mortality by receiver operating characteristic (ROC) curve analysis

Table (8): Diagnostic performance of the arterial blood gases in prediction the need for mechanical ventilation by receiver operating characteristic (ROC) curve analysis

Need for mechanical ventilation						
Predictor	**Cut off**	**Sensitivity %**	**Specificity %**	**AUC**	**95% CI**	**P-value**
pH	≤7.34	82.98	63.46	0.747	0.650 to 0.829	<0.001*
HCO3 (mEq/L)	≤12.6	61.70	69.81	0.676	0.575 to 0.766	0.001*
PaCO2 (mmHg)	≤17.6	21.28	94.34	0.572	0.469 to 0.671	0.2130
PaO2 (mmHg)	≤76	53.19	83.02	0.701	0.601 to 0.788	0.002*

***significant at p<0.05, AUC: area under the curve, CI: confidence interval, mmHg: millimeter mercury, mEq/L: milliequivalent per liter.**

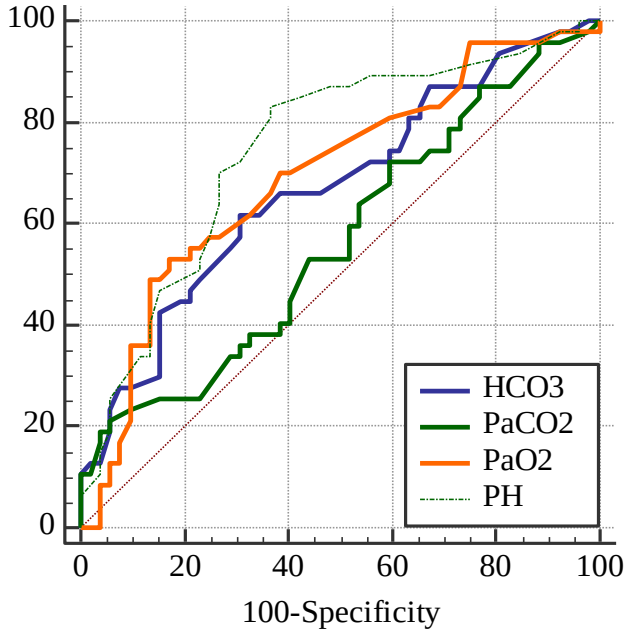

Figure (2): Diagnostic performance of the arterial blood gases in predicting the need for mechanical ventilation by receiver operating characteristic (ROC) curve analysis

DISCUSSION

In Egypt, ALP is a common self-poisoning agent owing to its low price and easy availability **(Gouda et al., 2018).** Detrimental effects of acute ALP poisoning are still a big deal with significant concerns. Hereafter, the current study aimed to evaluate acid-base disturbances at the time of admission as an outcome predictor in acute ALP poisoned patients.

Results of the current study revealed that socio-demographic, toxicological, and clinical data were comparable to findings in most poison control centers inside and outside Egypt **(Masoud & Barghash, 2013; Hassanian-Moghaddam & Zamani, 2016; Halvaei et al., 2017 and Hegazy et al., 2019).**

In the present study, the median pH value refers to the acidosis process (7.32). Over the years, data was gathered by **Shadnia et al. (2009), Arefi et al. (2011), El-Ebiary et al.(2015), El-Sarnagawy (2017), Navabi et al.(2018), and Wahdan & Khalifa (2020)** have revealed more or less comparable pH results.

Upon exposure of ALP to water, air moisture, or gastric hydrochloric acid releases phosphine gas that blocks the cytochrome C oxidase enzyme. Consequently, mitochondrial oxidative phosphorylation is inhibited by 70%**.** Furthermore, it disturbs mitochondrial morphology and inhibits mitochondrial protein synthesis and enzymatic activity. This can result in a blockage of the mitochondrial electron transport chain leading to a severe drop in mitochondrial membrane potential **(Bumbrah et al., 2012 and Neki et al., 2017).**

This elevates superoxide dismutase activity and reduces catalase levels, resulting in a high quantum of free radicals and acceleration of lipid peroxidation. The latter leads to cell membrane damage, disruption of the ionic barrier, and nucleic acid damage. In addition, it causes the denaturation of various enzymes involved in cellular respiration and metabolism to end with cell death **(Garg, 2020 and Vaidyanathan et al., 2020).**

Inadequate tissue perfusion induced by ALP poisoning could be attributed to

volume depletion caused by vomiting, myocardial depression, and adrenal insufficiency. Furthermore, inadequate systemic vasoconstriction, massive intravascular fluid loss resulting from increased capillary permeability, and decreased left ventricular ejection fraction could contribute to poor tissue perfusion **(Farnaghi et al., 2013 and Oghabian & Mehrpour, 2016**).

According to **Berry et al. (2015) and Garg (2020),** accumulation of lactic acid resulted from blockage of oxidative phosphorylation and inadequate tissue perfusion may account for acidotic pH changes gathered in the current study**.**

Both HCO3 and PCO2 regulate blood pH. To maintain a normal pH balance, the proximal tubules must reabsorb filtered HCO_3– and produce sufficient HCO_3– to neutralize the endogenous acid load. Furthermore, central nervous system neurons regulate ventilation to control plasma PCO_2 **(Boron, 2006 and Kraut & Madias, 2010).**

Significant determinants of HCO_3– reabsorption include luminal pH, luminal HCO_3– concentration, luminal flow rate, and peritubular PCO_2. Abnormality in any of the formers leads to impaired HCO_3– reabsorption. Metabolic acidosis promptly triggers hyperventilation that decreases $PaCO_2$, and this hypocapnia is beneficial for blunting a decrease in blood pH **(Kraut & Madias, 2010 and Seifter & Chang, 2016).**

The former data expected to gather a reduced level of HCO_3 and $PaCO_2$ in the current study (mean & median values of 14.4 meq/L & 25 mmHg, respectively). A result that comes parallel with comparable studies done by **Mathai & Bhanu (2010), Hosseinian et al. (2011), Vijayanath et al. (2011)**, **Nejad et al. (2012), Mashayekhian et al. (2016), Halvaei et al. (2017), Farzaneh et al. (2018)**, **and Ghonem et al. (2020).**

Partial oxygen pressure (PaO_2) median value was decreased in patients included in this study. A result that is shared with **Mathai & Bhanu (2010), Vijayanath et al. (2011)**, and **Farzaneh et al. (2018)**. According to **Anand et al. (2011)**, cardiogenic & non-cardiogenic pulmonary edema, pleural effusions, and respiratory distress syndrome are common findings in ALP intoxicated patients. Furthermore, cerebral anoxia induced by refractory shock might result in central nervous depression, including respiratory center, which might decrease PaO_2 (**Mehrpour et al., 2012a).**

Results of the current study have declared a significant decrease in pH value and PaO_2 on increasing ALP dose. **Hosseinian et al. (2011) and Navabi et al. (2018)** registered a higher number of ALP tablets in severely intoxicated patients who died. Blood pH value and PaO_2 showed a significant increase with an increased pre-hospitalization period. That could be explained by delays in seeking medical care in less severely intoxicated patients. However, according to **Hegazy et al. (2019),** the time passed till death occurred ranged from 1-48 hours, with most patients dying within 24 hours post-ingestion.

Significantly reduced SBP and DBP were recorded in this study with decreased levels of pH, HCO_3, $PaCO_2$, and PaO_2. **El-Sarnagawy (2017)** found that systolic and diastolic blood pressure was significantly lowered in severe ALP poisoned patients. At the same time, **Boukatta et al. (2013), Farzaneh et al. (2018), and Pannu et al. (2020)** demonstrated a significant association between SBP and severity of ALP poisoning. This resultant hypovolemic shock induces metabolic acidosis with a subsequent decrease of pH, HCO_3, $PaCO_2$, and PaO_2 **(Farahani et al., 2016).**

The respiratory rate was significantly elevated with decreased pH, HCO_3, $PaCO_2$, and PaO_2 as a compensatory mechanism for acidosis **(Jaiswal et al., 2009 and Kraut & Madias, 2010).** The dose of vasopressor was found to increase significantly with reduced pH and HCO_3. This could be explained by increased

vasopressor requirement with the severity of shock and subsequently reduced pH and HCO_3 **(Farahani et al., 2016 and Oghabian & Mehrpour, 2016**).

Period of hospital stay was noticed to be significantly decreased with a decrease of pH, $PaCO_2$, and PaO_2. A result that means increased severity known by decreased pH, $PaCO_2$ and PaO_2 will lead to mortality, hence, decreased hospital stay **(Hosseinian et al., 2011 and Hegazy et al., 2019).** On the other hand, the period of hospital stay was noticed to be significantly increased with the increase of pH, $PaCO_2$, and PaO_2 primarily due to less severe manifestation and more extended survival period.

A significant difference could be detected between survivors and non-survivors regarding pH, HCO_3, $PaCO_2$, and PaO_2. Furthermore, there was a significant difference between patients who required and did not require mechanical ventilation considering pH, HCO_3, and PaO_2. Comparable results were obtained by **Shadnia et al. (2009), Mathai and Bhanu (2010), Vijayanath et al. (2011), Navabi et al. (2018), Pannu et al. (2020), and Wahdan & Khalifa (2020).**

Providentially, pH, Hco_3, $PaCo_2$, and PaO_2 levels might predict mortality in acute ALP intoxication. It was determined that a pH cut-off value ≤of 7.33 could fairly predict death in 77.97 % of patients, and above this level, death could be excluded in 72.5% of patients. A cut-off value of $HCO_3 \leq 12.6$ could fairly predict death in 59.32 % of patients, and above this level, death could be excluded in 75.61% of patients. $PaCo_2$ cutoff value ≤ & > 27 could poorly predict and exclude death in 67.8% and 56.1% of patients respectively. A cut-off value of $PaO_2 \leq$ & >87.6 could goodly predict and exclude death in 76.27 % and 78.05% of patients, respectively.

In this study, pH, Hco_3, and paO_2 levels might predict the need for mechanical ventilation in acute ALP poisoning. It was found that pH cut-off value ≤7.34 could reasonably predict the need for mechanical ventilation in 82.98% of patients, and above this level, mechanical ventilation requirement could be excluded in 63.46% of patients. A cut-off value of $HCO_3 \leq$ & >12.6 could poorly predict and exclude mechanical ventilation requirement in 61.7 % and 69.81% of patients. PaO_2 Cut-off value ≤ & >76 could reasonably predict and exclude mechanical ventilation in 53.19% and 83.02 % of patients, respectively.

These data suggest that blood pH, HCO_3, and PaO_2 might be a guide to predict mortality in ALP poisoned patients; blood pH and PaO_2 might guide the need for mechanical ventilation. This is supported by data gathered by **Mathai &Bhanu, (2010), Masoud and Barghash, (2013), Navabi et al. (2018), Pannu et al. (2020), and Wahdan & Khalifa (2020).** They reported a range of fair to excellent pH and HCO_3 as predictors of mortality in acute ALP poisoned patients. Nevertheless, neither of them has included pH, Hco_3, $PaCo_2$, and paO_2 in the same study.

CONCLUSION

It could be concluded that determining blood pH, HCO_3, and PaO_2 on admission in acute ALP poisoned patients is a simple, cheap, and reliable marker that may help to predict mortality and mechanical ventilation requirement.

RECOMMENDATION

Further research on larger scales will be required to investigate and evaluate the predictive power of pH, Hco3, PaCo2, and paO2 as mortality predictors.

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الملخص العربى

الأهمية التنبؤية للاضطرابات القاعدية الحمضية بين المرضى الذين يعانون من التسمم الحاد بفوسفيد الألومنيوم

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يستخدم فوسفيد الألومنيوم في تخزين الحبوب كمبيد للقوارض والآفات. ويعد التسمم بفوسفيد الألومنيوم واحدا من أخطر أشكال التسمم الحاد التي يمكن أن تحدث بشكل عرضي أو انتحاري أو أثناء العمل في إنتاجه أو في تخزين الحبوب. وتتمثل أعراضه في الأضطرابات المعويه وهي الأكثر شيوعا في أعراض للتسمم الحاد بفوسفيد الألومنيوم، بالإضافه إلي الهبوط الحاد بالدورة الدموية ، وعدم انتظام ضربات القلب ، والاضطرابات القاعدية الحمضية. وقد كان الهدف من الدراسة الحالية هو تقييم الاضطرابات القاعدية الحمضية (وقت دخول المستشفي وقبل التدخل الطبي) كمؤشر بسيط للتنبؤ بنتائج التسمم الحاد بفوسفيد الألومنيوم. وتضمنت الدراسه 100 مريض بالغ من المصابين بالتسمم الحاد بفوسفيد الالومونيوم وقد تم استبعاد أصحاب الأمراض المزمنه كأمراض القلب أوالكلى أوالكبد. كما تم إستبعاد المرضي المحولين من مراكز طبيه أخري حال تلقيهم أي تدخلات علاجيه قبل وصولهم. حيث قمنا بتحليل غازات الدم الشرياني لجميع المرضى المنضمين للدراسه قبل تلقيهم لأي تدخلات علاجيه.

وقد تبين وجود فارق ذا دلالة احصائية بين الناجين وغير الناجين فيما يتعلق بمستوي حامضية الدم ، مستوى بيكربونات الصوديوم، الضغط الشرياني الجزئي لثاني أكسيد الكربون والضغط الشرياني الجزئي للأكسجين . بالإضافة إلى ذلك ، كان هناك فارق ذا دلالة احصائية بين المرضى الذين يحتاجون إلى تنفس صناعي والذين لا يحتاجون فيما يتعلق بمستوي حامضية الدم ، مستوى بيكربونات الصوديوم والضغط الشرياني الجزئي للأكسجين. وبذلك يمكننا إستنتاج أن الاضطرابات الحمضية في الدم قد تصلح للإستخدام كمؤشر سهل وغير مكلف للتنبؤ بنتائج التسمم الحاد بفوسفيد الألومنيوم مثل حدوث الوفاه أوالإحتياج للتنفس الصناعي.