Original article

Pattern and Outcome of Acute Aluminium Phosphide Intoxicated Cases at Sohag University Hospitals: Special Consideration to Paraffin Oil as a Supportive Treatment

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Abstract:

Introduction: In the last years poisoning by aluminium phosphide (AlP) became a common method of suicide with high mortality rates. **Aim of the work:** The study aimed to evaluate the characters and outcome of acute aluminum phosphide intoxicated cases at Sohag University Hospitals. **Patients and methods:** It is a cross sectional study conducted on acutely AlP intoxicated patients attended Sohag University Hospitals including a retrospective part from January 2020 to December 2021(23 case) and a prospective part from January 2022 to June 2022 (41 case). Demographic data, mode of poisoning, route of administration, amount taken, delay time, vital signs, degree of coma, ejection fraction, troponin I and creatinine levels and first aid measures were recorded then related them to the patient outcome. **Results:** the incidence of ALP toxicity increased every year, in 2020 was 10.9%, in 2021 (25%), while, in the first half of 2022 it was 64.1%. The mean age was 21.7± 10.65 with male predominance by 53.1%. There was a significant increase in percentage of survived patients decontaminated by paraffin oil (84.6%) compared to other methods (15.4%). Receiver operating characteristic curve (ROC) was used to assess predictors of mortality in acute ALP-poisoned patients. The accuracy rate of ejection fraction, poisoning severity score (PSS), dose, serum troponin I, systolic blood pressure, delay time, and HCO3 were 100%, 97.7%, 94.4%, 93.7%, 89.5%, 81.9%, and 80.1% respectively with excellent discrimination. Diastolic blood pressure (77.9%) and PH (75.2%) with acceptable discrimination. While, creatinine and GCS gave non-acceptable discrimination. **Conclusion:** the frequency of suicidal ingestion of ALP is increasing every year. Decontamination by paraffin oil and early presentation had a better prognosis. At admission assessment of ejection fraction, PSS, serum troponin and creatinine, blood pressure, ABG have a beneficial role as predictors of mortality and emergency intervention to cases with probable bad prognosis.

Key words: Aluminum phosphide, poisoning pattern, paraffin oil, outcome, mortality predictors.

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I. Introduction

Aluminum phosphide (ALP) is a common rodenticide and pesticide used in grain storage. ALP has many names in markets as Celphos, QuickPhos, RatKil and Salphos. Its poisoning occurs due to excessive exposure during fumigantion of stored cereal grains or as rodenticide. It is

highly toxic, especially when ingested from a recently opened container ***(More et al., 2022).***

In addition, it's a common manner of suicide especially in developing agricultural countries due to its low cost and easily availability. In Egypt, in the last few years AlP tablets became a common method to commit suicide and also became a common cause of admission to poison control centers. The mortality from ALP poisoning is ranges from 40 to 91% even in skilled and well-equipped hospitals ***(Sheta et al., 2019 &Deraz et al., 2022).***

ALP poisoning results from the libration of phosphine gas (PH3) after coming in contact with either atmospheric moisture or with hydrochloric acid in the stomach. The mechanism of phosphine toxicity is by inhibition of cytochrome c oxidase and other enzymes which result in generation of free radicals as superoxide which cause lipid peroxidation and other oxidant mechanisms causing cell death and disruption of the function vital organs, specially brain, lungs, and liver ***(Vaidyanathan et al., 2020 & Bagherian et al., 2021).***

Gastrointestinal manifestations (nausea, vomiting, and epigastric pain), cardiovascular disorders (hypotension, shock, tachycardia or bradycardia, and congestive heart failure), central nervous system manifestations (headache and coma), and severe metabolic acidosis are the most common clinical presentations of ALP poisoning. The most frequent cause of death from ALP poisoning is severe metabolic acidosis-induced life-threatening cardiac arrhythmias ***(Majidi et al., 2021).***

Laboratory abnormalities associated with AlP poisoning include leucopenia, leukocytosis, increased urea and creatinine levels, elevated serum glutamic oxaloacetic transaminase (SGOT) and serum glutamic pyruvic transaminase (SGPT), metabolic acidosis and electrolyte abnormalities of serum potassium and magnesium ***(Bogale et al., 2021).***

The main management of ALP poisoning is by supportive measures as there is no specific antidote in the form of saving air way, optimizing blood pressure and to prevent hypoxia of the tissues. Also, gastric lavage by potassium permanganate and mineral oil or coconut oil found to decrease mortality after ALP poisoning ***(Jan et al., 2021).***

As AlP is highlywater-soluble so oils were used instead of aqueous solutions in gastric decontamination to prevent the libration of phosphine gas. One of these oils is liquid paraffin oil which also reduces

phosphine absorption from the gastric mucosa. In addition, paraffin oil hastens phosphides excretion from GIT by increasing its peristalsis ***(Darwish et al., 2020).***

II. Patients &Methods:

Type of study:

The present study is a cross sectional study which was conducted on acutely ALP intoxicated patients attended Sohag university hospitals.

The study included two parts: A retrospective part involved two years (during the period from January 2020 to December 2021) including 23 case and a prospective part involved six months from January 2022 to June 2022 including 41 cases.

Patients:

1- Retrospective part: files for patients attended Sohag University Hospitals were revised to select all ALP intoxicated patients who fulfilled the inclusion criteria during the specified period (from January 2020 to December 2021).

2- Prospective part: all patients with sure history of ALP intake only attended Sohag University Hospitals during the specified period (from January 2022 to June 2022) were evaluated clinically and managed as well.

Inclusion criteria:

- All patients attended Sohag University Hospitals in the specified periods with history of acute ALP intoxication.

Exclusion criteria:

- Patients co-ingested other drugs or toxins with ALP whatever accidentally or intended were excluded.
- Patients with history of any disease or condition that may alter outcome results were excluded.

Tools of the study:

1-A prepared sheet containing the demographic characteristics of each patient (including gender, age and residence), also mode of poisoning, route of administration, amount of ALP consumed, and the time elapsed between the toxin consumption and admission) was filled.

2- Vital signs were recorded at time of admission.

3- The degree of coma was assessed by GCS (Glasgow coma scale) (3-15 points) which was calculated by sum of assessment of motor, verbal and eye components, and PSS (poisoning severity score) classifies as follow:

- None, no symptoms or signs related to poisoning (0)

- Minor, mild or transient symptoms (1),
- Moderate, prolonged symptoms (2),
- Severe, and life-threatening symptoms or signs (3),
- Fatal death (4). ***Shokry Zaghary et al. (2021)***

4- Ejection fraction of the heart was evaluated by echocardiography in addition to troponin I and creatinine in the prospective part of the study.

5- First aid management as resuscitation and paraffin oil intake were recorded either the patient received them before arrival to Sohag university hospitals or after their arrival. Also other lines of treatment were recorded as intravenous fluids, nothing per oral for 48hours, sodium bicarbonate if metabolic acidosis present and N acetyl cysteine if renal or liver enzymes affected.

Statistical analysis:

The collected data had been coded and verified prior to computerized data entry. The collected data statistically analyzed using Statistical Package for the Social Science (SPSS) version 23 program and expressed in tables and graphs. The Quantitative data was tested for normality by Kolmogorov-Smirnov then represented in mean and standard deviation then analyzed by ANOVA or independent t- test. Qualitative data was presented as number and percentage and compared using either Chi square test or fisher exact test. Roc curve analysis was used to detect the best cutoff of different variables. Sensitivity, specificity, positive predicted value, and negative predictive value were also calculated that helped to predict outcome. In all analysis, P value < 0.05 indicated statistical significance.

Ethical conditions:-

Ethical approval was obtained from the Medical Research Ethics Committee of Faculty of Medicine - Sohag University, according to the commitment standard operating procedure guidelines. On 29/12/2021 under IRB Registration number: Soh-Med-21-12-41. Patients' records had been reviewed and data was anonymously collected in the retrospective part of the study. In the prospective part an informed consent obtained from all patients or their relatives if the patient was a child or disturbed before participation.

III. Results:

The current study was a cross-sectional study carried out on acutely ALP intoxicated patients attempted Sohag University Hospitals which were about 64 patients. Patients were 23 cases recorded from the retrospective part which involved two years (during the period from January 2020 to December 2021) and 41 cases from the

prospective part involved six months from January 2022 to June 2022.

The mean age of all patients included in the study was 21.7± 10.65, median 20 IQ (17: 27.25) with no significant difference between the mean age in the 3 sequences years as P >0.05 (Table 1).

Table (2) illustrated that the incidence of toxicity by ALP increased every year, in the year 2020 was just 10.9% of patients included in the study, and in the year 2021 (25%), while, in the first half of the year 2022 was 64.1% with statistically significant difference between years as P<0.05. Males increased slightly (53.1%) more than females (46.9%). Most of the patients were from rural areas (82.8%) than urban areas (17.2%). The suicidal mode of toxicity was 84.1% while, the accidental mode was only (15.9%). Oral was the main route of exposure (98.4%). The difference between the 3 sequences years was insignificant regards gender, residence, mode of toxicity, and route of exposure as P >0.05.

Table (3) showed that doses that were taken by patients varied from a quarter of one tablet to two tablets without a statistically significant difference between years as P >0.05. There was (65.6%) of patients who took pre-consultation before arrival at Sohag University Hospitals without statistically significant difference between years as P > 0.05. As regards decontamination in 9.4% of patients nothing was done to them, lavage by water with or without bicarbonate was done to (25%) of patients, and (65.6%) of patients took paraffin oil with a statistically significant difference between years of the study (P<0.05) as paraffin oil was not used in the management of the patients in the year 2020 but was used in 2022 more than the year 2021. Regarding outcome and survival in this study (39.1%) of patients died, while, (60.9%) survived divided into 48.4% with complete recovery and 12.5% recovered with complications, the percentage of mortality increased in the year 2020 (57.1%) than the year 2021 (31.2%) and year 2022 (39%) but without a statistically significant difference as P> 0.05.

At the time of admission vital signs, coma scales, dose and important investigations were recorded and tested for normality, and means and standard deviations were calculated and related to the outcome.

There was a significant statistical decrease in the mean of systolic blood pressure, diastolic blood pressure, GCS, PH, HCO3 and ejection fraction in non -survivors than in survivors as P<0.05. In addition, there was a significant statistical increase in the mean of PSS, creatinine, troponin I, delay

time per hour until arrival to the tertiary center, and the dose is taken by patients in non-survivors than in survivors as P<0.05. While, there was no statistically significant difference in the mean value of pulse rate between survivors and non-survivors as P > 0.05 (Tables, 4 &5).

By constructing ROC curve analysis to assess the predictors of mortality cleared that the accuracy rate of ejection fraction was the highest (100%), then PSS (97.7%), the dose taken by patients (94.4%), serum troponin I (93.7%), systolic blood pressure (89.5%), delay time per hours (81.9%), HCO3 (80.1%), Diastolic blood pressure (77.9%) and finally PH (75.2%), while, creatinine and GCS gave insignificant low accuracy rate as P > 0.05 (Table 6).

Figures (1&2) illustrated that the true-positive rate (sensitivity) against the false-positive rate (1-specificity) at each point were plotted. The best cut-off points used with the best sensitivity and specificity to predict mortality in acute ALP toxicity were ejection fraction <35%, the dose >0.75 of the tablet, serum troponin I > 0.5 ng /ml, Systolic blood pressure <85 mmHg, delay time > 1.5 hours, HCO3 <12.5, diastolic blood pressure <55mmHg and PH <7.3.

Finally, to assess the efficacy of paraffin oil as a new method of decontamination in comparison to lavage by water and doing nothing, there was a significant statistical increase in the percentage of survived patients decontaminated by paraffin oil (84.6%) compared to other methods (15.4%). While, in non-survived, there was a significant statistical decrease in the percentage of dead patients decontaminated by paraffin oil (36%) than other methods (64%) showing the efficacy of using paraffin oil to other methods concerning the outcome as P < 0.05 (Table 7).

Table :1 Mean, standard deviation, median, interquartile of the age and p value of the studied patients admitted to Sohag University Hospitals from January 2020 to June 2022 by ANOVA test.

Characteristics	Year 2022 N=41(100%)	Year 2021 N=16 (100%)	Year 2020 N=7 (100%)	Total Cases N=64 (100%)	P value
Age (years) Mean ± SD	21.91±11.18	21.09±9.46	21.86±10.65	21.7±10.65	0.966
Median (IQ)	20.0 (16.0: 26.0)	19.5 (17.0: 25.0	22.0 (18.0: 23)	20 IQ (17: 27.25)	by ANOVA

IQ: interquartile SD: standard deviation N: number of patients

Table 2: Frequency, sex, residence, mode of toxicity and route of exposure percentages difference of the studied patients admitted to Sohag University Hospitals from January 2020 to June 2022by Chi-square test.

Characteristics	Year 2022 N=41(100%)	Year 2021 N=16 (100%)	Year 2020 N=7 (100%)	Total Cases N=64 (100%)	P value
Frequency/ (percentage)	41 (64.1%)	16 (25%)	7 (10.9%)	64 (100%)	0.000***
Sex					
Male	24 (58.5%)	6 (37.5%)	4 (57.1%)	34 (53.1%)	0.351(NS)
Female	17 (41.5%)	10 (62.5%)	3 (42.9%)	30 (46.9%)	
Residence					
Urban	7 (17.1%)	2 (12.5%)	2 (28.6%)	11(17.2%)	0.643 (NS)
Rural	34 (82.9%)	14 (87.5%)	5 (71.4%)	53 (82.8%)	
Mode of toxicity					
Suicidal	34 (82.9%)	13 (86.7%)	6 (85.7%)	53 (84.1%)	0.94 (NS)
Accidental	7 (17.1%)	2 (13.3%)	1 (14.3%)	10 (15.9%)	
Route of exposure					
Oral	40 (97.5%)	15 (100%)	7 (100%)	63 (98.4%)	0.8 (NS)
Inhalation	1 (2.5%)	0 (0%)	0 (0%)	1 (1.6%)	

*P < 0.05 (significant) **P < 0.01 (highly significant) ***P < 0.001 (very highly significant)
NS: Non significant p >0.05 N: number of patients

Table 3: Dose, pre-consultation, decontamination, outcome and survival percentage difference of the studied patients admitted to Sohag University Hospitals from January 2020 to June 2022 by Chi-square test.

Characteristics	Year 2022 N=41(100%)	Year 2021 N=16 (100%)	Year 2020 N=7 (100%)	Total Cases N=64 (100%)	P value
The dose taken by the case					
0.25 tab	3 (7.3%)	0 (0%)	0 (0%)	3 (4.7%)	0.633 (NS)
0.5 tab	16 (39%)	6 (37.5%)	1(14.3%)	23 (35.9%)	
1 tab	17 (41.5%)	8 (50%)	4 (57.1%)	29 (45.3%)	
2 tab	5 (12.2%)	2 (12.5%)	2 (28.6%)	9 (14.1%)	
Pre-consultation					
YES	28 (68.3%)	8 (50%)	6 (85.7%)	42 (65.6%)	0.21 (NS)
NO	13 (3 1.7%)	8 (50%)	1 (14.3%)	22 (34.4%)	
Decontamination					
No	5 (12.2%)	1 (6.3%)	`0 (0%)	6 (9.4%)	0.000***
Lavage by water & bicarb	3 (7.3%)	6(37.5%)	7 (100%)	16 (25%)	
Paraffin oil	33 (80.5%)	9 (56.3%)	0 (0%)	42 (65.6%)	
Outcome					
Complete recovery	23 (56.1%)	7 (43.8%)	1 (14.3%)	31 (48.4%)	0.07 (NS)
Recovery with complications	2 (4.9%)	4 (25%)	2 (28.6%)	8 (12.5%)	
Mortality	16 (39%)	5 (31.3%)	4 (57.1%)	25 (39.1%)	
Survival					
Survived	25 (61%)	11 (68.8%)	3 (42.9%)	39 (60.9%)	0.50 NS
Died	16 (39%)	5 (31.2%)	4 (57.1%)	25 (39.1%)	

*P < 0.05 (significant) **P < 0.01 (highly significant) ***P < 0.001 (very highly significant)
NS: Non significant p >0.05
N: number of patients

Table 4: Comparison between survivors and non-survivors as regards different studied parameters at time of admission of the studied patients admitted to Sohag University Hospitals from January 2020 to June 2022 by independent t- test.

Variable		Survivors	Non-Survivors	Total	Independent t-test p-value
Pulse	Mean± SD	97.68± 22.7	105.4±24.4	101.1±23.6	0.25 NS
Systole	Mean± SD	100.9±14.6	72.1±18.8	88.77±21.8	0.000***
Diastole	Mean± SD	63±11.5	47.3± 13.5	56.7±14.5	0.000***
PH	Mean± SD	7.3±0.09	7.1±0.14	7.24±0.15	0.001**
HCO3	Mean± SD	17.7 ± 4.8	12.3± 4.7	14.9±5.4	0.004**
GCS	Mean± SD	14.8±0.6	12.3±4.7	13.8± 3.1	0.002**
PSS	Mean± SD	1.64± 0.62	3.5±0.5	2.3± 1.1	0.000***
Creatinine	Mean± SD	0.86± 0.7	1.7±1.0	1.2± 0.9	0.047*
Troponin I	Mean± SD	0.4 ±0.6	4.1 ±3.4	2.1± 2.9	0.004**
Ejection Fraction of heart	Mean± SD	57.6± 6.8	25.1±4.9	44.94± 17.1	0.000***
Delay time per hours	Mean± SD	2.06± 1.3	3.7±2.4	2.7± 2.0	0.003**
Dose	Mean± SD	0.66 ±0.26	1.3±0.5	0.9±0.5	0.000***

*P < 0.05 (significant) **P < 0.01 (highly significant) ***P < 0.001 (very highly significant)
NS: Non significant P > 0.05 SD: Standard deviation
GCS: Glasgow Coma scale PSS: poisoning severity score

Table 5: Linear regression analysis of important studied parameters as predictors of outcome in the studied patients admitted to Sohag University Hospitals from January 2020 to June 2022.

Predictors	Un-standardized Coefficients		Standardized Coefficients	Independent t-test	
	B	Std. Error	Beta	T	p-value
Pulse	0.004	0.003	0.165	1.16	0.25 NS
Systole	-0.015	0.002	-0.659	-6.492	0.000***
Diastole	-0.018	0.004	-0.537	-4.679	0.000***
PH	-1.85	0.49	-0.553	-3.75	0.001**
HCO3	-0.047	0.015	-0.506	-3.158	0.004**
GCS	-0.05	0.018	-0.379	-0.322	0.002**
PSS	0.369	0.030	0.841	12.26	0.000***
Creatinine	0.257	0.119	0.475	2.15	0.047*
Troponin I	0.112	0.033	0.643	3.35	0.004**
Ejection Fraction of the heart	-0.027	0.001	-0.934	-20.52	0.000***
Delay per hours	0.098	0.031	0.4	3.14	0.003**
Dose	0.644	0.093	0.662	6.94	0.000***

*P < 0.05 (significant) **P < 0.01 (highly significant) ***P < 0.001 (very highly significant)
NS: Non significant P > 0.05 SD: Standard deviation
GCS: Glasgow Coma scale PSS: poisoning severity score

Table 6: Sensitivity, specificity and accuracy rate of important parameters as predictors of mortality in the studied patients admitted to Sohag University Hospitals from January 2020 to June 2022.

Variable	Cut off point	AUC (Area under the curve)	P-value	Sensitivity (%)	Specificity (%)	PPV (%) (Positive predictive value)	NPV (%) (Negative predictive value)	Accuracy rate
Ejection Fraction	<35%	1.0	0.000***	100%	100%	100%	100%	100%
PSS	>3.5	0.977	0.000***	60%	100%	100%	79.5%	97.7%
Dose	>0.75	0.944	0.002**	100%	77.8%	64.1%	100%	94.4%
Troponin I	>0.5ng/ml	0.937	0.002**	100%	66.7%	72.7%	100%	93.7%
Systole	<85mmHg	0.895	0.000***	93.8%	78.6%	74.1%	93.9%	89.5%
Delay time	>1.5 hr	0.819	0.027*	87.5%	66.7%	70.9%	90.9%	81.9%
HCO3	<12.5	0.801	0.005**	62.5%	92.9%	84.2%	80%	80.1%
Diastole	<55mmHg	0.779	0.009**	81.3%	64.3%	41.6%	62.5%	77.9%
PH	<7.3	0.752	0.019*	93.8%	50%	54%	90.9%	75.2%
Creatinine	>1.24	0.708	0.147 NS	71.4%	90.9%	81%	83.3%	70.8%
GCS	<9	0.603	0.339NS	25%	100%	100%	67.4%	60.3%

* P < 0.05 (significant) **P < 0.01 (highly significant) ***P < 0.001 (very highly significant)
NS: Non significant P > 0.05 GCS: Glasgow Coma scale PSS: poisoning severity score

Table (7): Comparison between paraffin oil intervention and other lines of decontamination regarding the outcome in the studied patients admitted to Sohag University Hospitals during the period from January 2020 to June 2022 by Chi-square Test.

Decontamination	Survivors	Non-survivors	Total	
Nothing or lavage by water	6 (15.4%)	16 (64%)	22 (34.4%)	0.000***
Paraffin oil	33 (84.6%)	9 (36%)	42 (65.6%)	by chi-square
Total	39 (60.9%)	25 (39.1%)	64 (100%)	

***P < 0.001 (very highly significant)

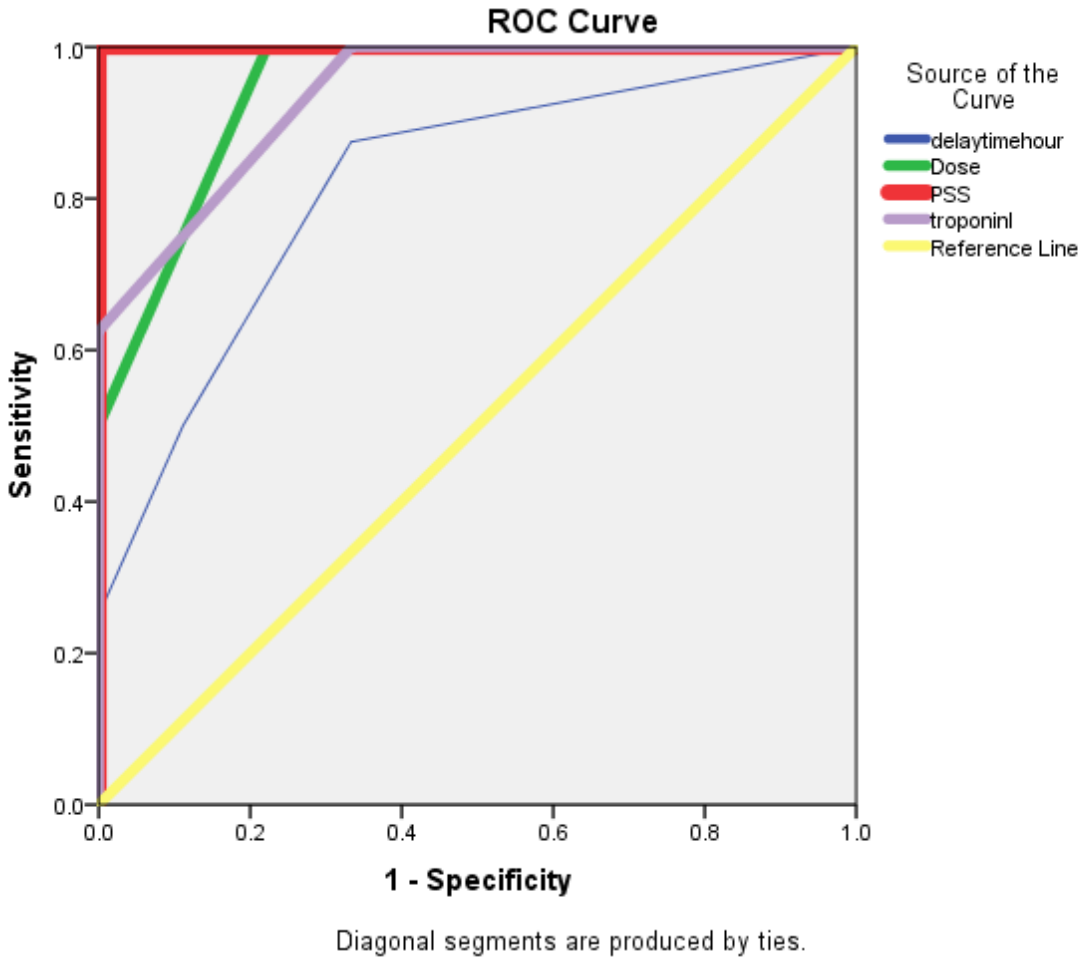

Figure 1: Receiver Operator Characteristic (ROC) Curve of PSS (poisoning severity score), dose, delay time and troponin I when a larger result is positive in the studied patients admitted to Sohag University Hospitals during the period from January 2020 to June 2022.

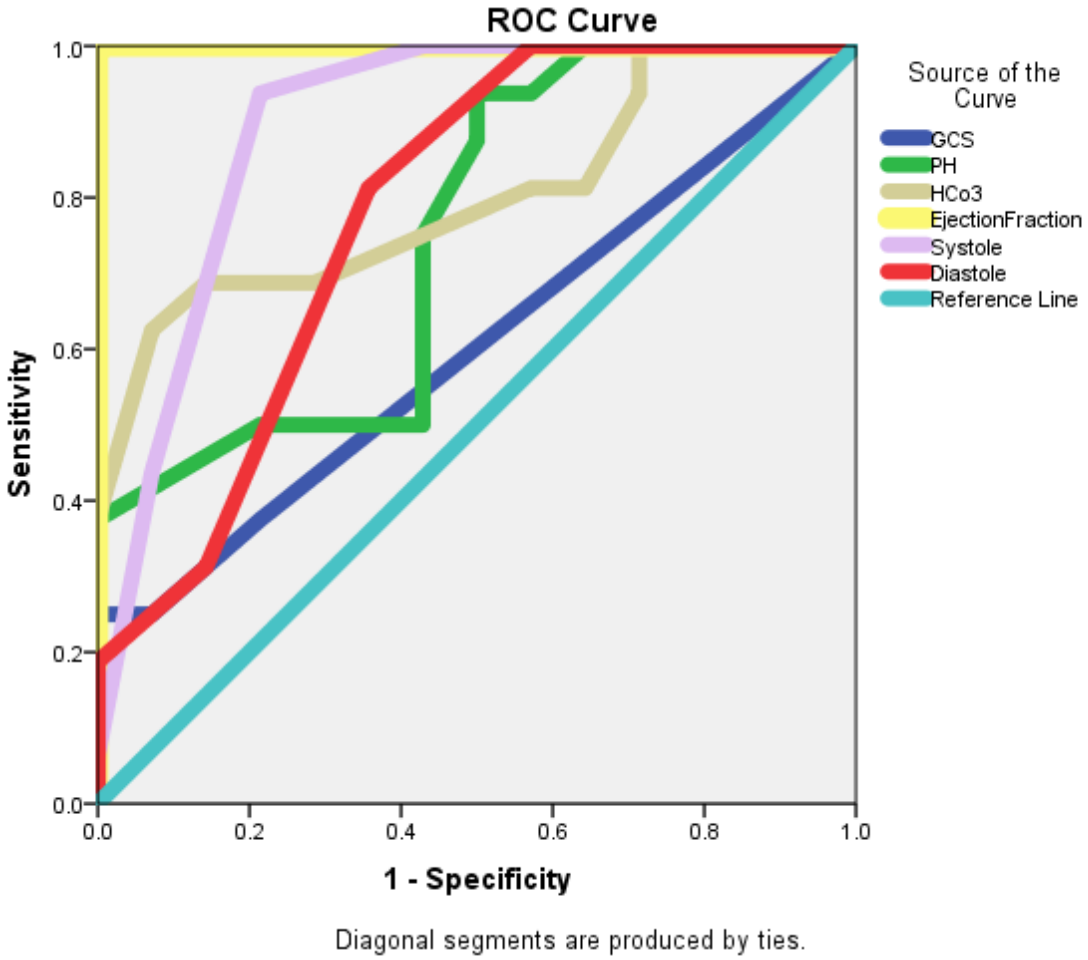

Figure 2: Receiver Operator Characteristic (ROC) curve of (Glasgow coma scale), systolic and diastolic blood pressure, ejection fraction, PH, and HCO3 when a smaller result is positive in the studied patients admitted to Sohag University Hospitals during the period from January 2020 to June 2022.

IV. Discussion:

The current study illustrated that toxicity by ALP increased every year as in the year 2020 was just 10.9% from patients included in the study and year 2021 (25%), while, in the first half of the year 2022 was 64.1% with significant difference between years as P<0.05.

This is due to increasing public recognition of AlP poison in Egypt as an effective suicidal poison that is cheap, and available so cases could get it very easily especially with laxity to perform limits for its sale and without an effective antidote. Hence, the incidence of AlP poisoning is rising steadily at an alarming rate, reflecting the AlP increased use for both agricultural

and non-agricultural purposes and accounts for a considerable percentage of patient's admission to poison control centers ***(Gargi et al., 2006; Soltaninejad et al., 2012; Sheta et al., 2019; Deraz et al., 2022).***

The mean age of all patients included in the study was 21.7± 10.65, a median of 20 IQ (17: 27.25) with no significant difference between the mean age in the 3 sequences years as P>0.05. The mean age of the study is nearly similar to ***Rahbar et al. (2006)*** who found that most of the cases of AlP toxicity were in the age group of 15-30 years, with an average age of 29 years.

Also, ***Khodabandeh et al. (2014)*** illustrated that most of the cases of toxicity came within the age group 15-24 years.

In Iran, ***Etemadi-Aleagha et al. (2015)*** showed that most of the patients were somewhere in the range of 20 and 40 years of age.

The study found that males were slightly increased (53.1%) than females (46.9%) who came with acute AlP toxicity this was in harmony with the results of ***Khodabandeh et al. (2014)*** and ***Navabi et al. (2018)*** studies. This may be explained due to the occupational accessibility of AlP tablets to males than females in addition to the financial stress they face for their families (***Deraz et al., 2022).*** On the contrary ***Darwish et al. (2020)*** found that females were more dominant due to their liability for suicidal attempts to gain sympathy.

Most of the patients were from rural areas (82.8%) than urban areas (17.2%). This was similar to ***Siwach et al. (1998); Mehrpour et al. (2012) ; Sheta et al., (2019***) as they reported that most of their cases were from rural areas as those areas more related to exposure to AlP toxicity due to low education, poverty and occupational accessible of AlP***. (Sheta et al., 2019)***

The suicidal mode of toxicity was 84.1% while, the accidental mode was only (15.9%) and no homicidal cases and the oral route was the main route of exposure in the present study. Also, ***Qureshi et al. (2018)*** showed that intentional oral ingestion of wheat-preserving pills was about 80% of AlP toxicity cases as younger age groups were more liable to self-poisoning due to peer pressure, family disputes and failure in love, while, accidental oral ingestion poisoning occurred in about 20% of cases and no homicidal cases.

Another Iranian research revealed that 93% of cases were self-harming with a self-destructive expectation which concurs with this study that the most common reason

for harming is suicidal ***(Mwaheb &Hassan, 2021).***

Doses taken by patients varied from a quarter of one tablet to two tablets without significant difference between years as P>0.05. Most of the studied patients (45.3%) administrated about one table.

This is in harmony with ***Rahbar et al. (2006)*** who reported that a large proportion of the cases (41.2%) consumed about 1 tablet.

Also, ***Bogalae et al. (2021)*** showed that about half of cases took about 1 tablet and the majority of cases took doses varied from half a tablet to 2 tablets.

As regards decontamination, (9.4%) of patients nothing was done to them. While 25% of patients decontaminated by lavage by water either with or without bicarbonate and (65.6%) of patients took paraffin oil. There was a statistical significant difference between the studied years concerning decontamination (P<0.05). Paraffin oil was not used in the year 2020 but was used to a lesser degree in 2021 and in 2022 most of the cases were decontaminated by paraffin oil.

This could be explained by ***Darwish et al. (2020)*** who illustrated that due to no effective antidote along with the rapid increased in several AlP fatalities, many studies researched decontamination strategies to decrease toxicity. AlP tablets dissociate easily in an aqueous solution liberating phosphine gas which is responsible for fatal effects. Therefore, many recent researchers and physicians recommended GIT decontamination by oils like paraffin to surround the tablet and decrease the liberation of phosphine gas instead of gastric lavage with water.

Regarding outcome and survival in this study (39.1%) of patients died, while, (60.9%) survived divided into 48.4% with complete recovery and 12.5% recovered with complications, the percentage of mortality increased in the year 2020 (57.1%) than the year 2021 (31.2%) and year 2022 (39%) without a significant difference as P> 0.05.

This is in harmony with other researchers ***Kalawat et al.(2016); Bogale et al. (2021) and Mwaheb and Hassan (2021);***, they reported lower mortality of around 35%. While, higher mortality rate with a mean of about 70% was reported by ***Siwach et al. (1998); Mathai and Bhanu (2010) and Singh et al. (2014)***, also, ***Saleh and Makhlof*** **(2018)** reported a high mortality rate reached up to 92%. The varying percentages of acute AlP poisoning mortality were reported by many authors

Moghadamnia (2012)*; *Farahani et al. (2016); El-Sarnagawy (2017); Abdel-Hady et al. (2019) and Elgazzar et al. (2022); that mortality varied from low 30% up to 100% even in highly well-equipped and qualified centers in Egypt and other agricultural countries engaged with AlP poisoning cases ***(Deraz et al., 2022).***

There was a significant statistical decrease in the mean value of systolic blood pressure, diastolic blood pressure, GCS, PH, HCO3, ejection fraction, and duration of stay by days in non-survivors than in survivors as P<0.05. In addition, there was a significant statistical increase in the mean of PSS, creatinine, troponin I, delay time per hour until arrival to a tertiary center, and the dose taken by patients in non-survivors than in survivors as P<0.05. While there was an insignificant mean difference in pulse rate between survivors and non-survivors as P> 0.05.

Similarly, ***Sheta et al. (2019)*** demonstrated that was a significant p-value between survivors and died as all non-survivors had EF less than 40% as the mortality rate reached 100% if there was severe left ventricular dysfunction.

Regarding the coma scale like the present study, ***Darwish et al. (2020)*** reported that most of the AlP poisoning cases were conscious at admission and then deteriorated later with the progress of cardiogenic complications showing decreased GCS levels in non survivors. Also, that study cleared that serum cardiac troponin can be increased and ejection fraction of the heart decreased when phosphine gas is released and cause direct myocardial injury.

A delay time between ingestion of toxin and receiving management in tertiary center significantly increased in non survivors than survivors which was against the study of ***El-Sarnagawy (2017)*** who found no significant difference between survivors and dead cases regarding delay time, while, similar to us ***Abdel- Navabi et al. (2018) and Hady et al. (2019)*** found it was a significant factor.

The dose of AlP taken by the patient was highly significant between survivors and non-survivors this is similar to ***El-Sarnagawy (2017); Navabi et al. (2018); Sharma et al. (2018) and Bogale et al. (2021).***

The blood pressure was related to mortality in acute AlP toxicity that goes with the result of ***El-Sarangawy (2017*) *and Sheta et al. (2019)***.

Shokry Zaghary et al. (2021) demonstrated a significant statistical

increase in the mean value of PSS in non-survivors than survivors of acutely poisoned patients. Also, they demonstrated a non significant difference in the mean value of pulse rate between survivors and non-survivors in acutely poisoned patients.

Many studies like ***Kalawat et al. (2016); El-Sarnagawy (2017); Abdel-Hady et al. (2019); Ghonem et al. (2020); Elgazzar et al. (2022) and El-Sarnagawy et al. (2022)*** agree with the current study and showed a significant mean decrease in PH and HCO3 in non survivors than survivors.

Serum creatinine was significantly higher in non survivors than in survivors, this was in harmony with ***Deraz et al. (2022)***.

In the current study ROC curve analysis was used to assess predictors of mortality in acute AlP-poisoned patients. The accuracy rate of ejection fraction, PSS, dose, serum troponin I, systolic blood pressure, delay time per hour, and HCO3 were 100%, 97.7%, 94.4%, 93.7%, 89.5%, 81.9%, and 80.1% respectively with excellent discrimination. Diastolic blood pressure (77.9%), and finally PH (75.2%) with acceptable discrimination while, creatinine and GCS gave non-acceptable discrimination as P> 0.05.

Best cut off value of EF<35%, PSS >3.5, dose >0.75, troponin I>0.5ng/ml, systole <85mmHg, delay time> 1.5hr, HCO3<12.5, diastole<55mmHg and PH <7.3 predicted mortality with 100%, 60%, 100%, 100%, 93.8%, 87.5%, 62.5%, 81.3% and 93.8% sensitivity and 100%, 100%, 77.8%, 66.7%, 78.6%, 66.7%, 92.9%, 64.3% and 50% specificity respectively.

Similarly, ***Sagah and Elhawary (2022)*** found that the cut-off value of HCO3 <12.6 and PH<7.33 had showed acceptable sensitivity and specificity to predict mortality in acute AlP poisoning. In addition, ***Farzaneh et al. (2018)*** added that systolic blood pressure of <92.5 mmHg had a good accuracy rate in acute AlP toxicity prediction of mortality.

Concerning the assessment of the coma scale in opposition to the present study ***Shokry et al. (2020)*** demonstrated that GCS at cut-off <9.5 had a high accuracy rate and excellent discrimination of predicting outcome in acute poisoning cases of about 92%. Also, ***Shokry Zaghary et al. (2021)*** showed that GCS <9 had an acceptable accuracy rate of about 80% in predicting fatality in acute poisoning, while, their results were in harmony with the current study regarding PSS as showed that PSS>2 showed high accuracy rate 92%.

Hilal et al. (2020) showed that serum troponin I >1.0 ng/ml had a high accuracy rate of 96%, a sensitivity of 100%, and a specificity of 89% in predicting bad prognosis in acute toxicity.

Similarly, ***Sheta et al. (2019)*** illustrated that EF test less than 40% in acutely poisoned AlP toxicity had sensitivity 100% with a positive predictive value of 100% as all non survived patients had EF <40%. Also, they demonstrated that delay in treatment result in more absorption of phosphine gas and affection of organs causing rapid death and a significant increase difference in delay time in non-survivors than survivors. In addition they reported that the higher the dose ingested the more liability of mortality.

In the present study, it was found that there was a significant statistical increase in the percentage of survived patients decontaminated by paraffin oil (84.6%) compared to other methods (15.4%). While in non-survived, there was a statistical significant decrease in the percentage of dead patients decontaminated by paraffin oil (36%) than other methods (64%) showing the efficacy of using paraffin oil to other methaboutn to outcome.

This result in harmony with a study done by ***Darwish et al.(2020)*** who found that the survival rate in patients who received paraffin oil was 63.33% while those who received traditional gastric lavage with an aqueous solution the survival was 26.67%. In addition, the percentage of patients discharged without sequelae was 36.67 in patients received paraffin oil while it was only 16.67% in those who received traditional gastric lavage with an aqueous solution.

Also, **Shakeri et al. (2021)** stated that one of the key approaches in AlP poisoning can be a quick transfer to the hospital, no stomach lavage, the use of paraffin, a quick study of arterial blood gas, laboratory testing to assess sodium, potassium, calcium, and magnesium, electrocardiography, and things like antacid administration. According to **Schonwald et al. (1994)**, repeated lavage with sorbitol and mineral oils helped to delay the release of phosphides and speed up excretion.

As AlP is highly water-soluble, phosphine gas is rapidly released when it comes in contact with an aqueous solution. So, gastric lavage with aquase solutions should be avoided in AlP poisoning treatment. Instead, castor oil or vegetable oils are preferred for gastric lavage to limit the release of phosphine gas and stimulate

luminal evacuation ***(Sanaei-Zadeh & Marashi, 2016).***

In previous studies, It was discovered that paraffin oil reduced the emission of phosphine gas by limiting AlP's reaction with water and stomach acid and by decreasing phosphine absorption from the gastric mucosa. In addition, paraffin oil increase phosphide excretion by enhancing GIT motility ***(Agrawal et al., 2015 & Farahani et al., 2016).***

V. Conclusion:

The current study concluded that the frequency of suicidal ingestion of wheat-preserving pills increasing every year. Cases decontaminated by paraffin oil had good prognosis than conventional lavage especially if the patient came early after toxicity without a long delay as paraffin oil surrounded the pill decreased releasing of phosphine gas. Also, cases ingested more than one tablet had a bad prognosis. At admission assessment of ejection fraction, poison severity score, serum troponin, blood pressure, arterial blood gas, and serum creatinine as the study concluded that these parameters had a beneficial role as predictors of mortality and emergency intervention to cases with probable bad prognosis.

VI. Recommendations:

ALP trade should be prohibited by ministry of agriculture because of its high mortality especially by suicide manner as it is cheap and easily available. Also, increase the community awareness specially farmers about ALP dangerous and fatal effects through the community education programs. Paraffin oil use as a supportive treatment is recommended because of its clinically proved role in improving the outcome and decreasing mortality after intoxication with ALP.

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الملخص العربى

نمط ونتائج حالات التسمم الحاد بفوسفيد الألومنيوم بمستشفيات سوهاج الجامعية: اعتبارات خاصة لزيت البارافين كمكمل علاجي

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المقدمة: في السنوات الأخيرة لقد أصبح التسمم بفوسفيد الألومنيوم في السنوات الأخيرة والذى يعد أحد أكثر المبيدات المستخدمة للحفاظ على الحبوب انتشارا ، وسيلة شائعة للانتحار مع ارتفاع معدلات الوفيات الناجمة عنه. **الهدف من البحث:** تقييم خصائص ونتائج التسمم الحاد بفوسفيد الألومنيوم. **طريقة البحث**: هو دراسة مقطعية أجريت على المرضى المصابين بالتسمم الحاد بفوسفيد الالومنيوم الذين تم استقبالهم بمستشفيات سوهاج الجامعية ويشتمل على جزء مرجعى (من يناير 2020 إلى ديسمبر 2021) جزء مستقبلى (من يناير 2022 إلى يونيو 2022). وقد تم تسجيل البيانات الديموغرافية وطريقة التسمم وطريقة التناول والكمية المأخوذة ووقت التأخير والعلامات الحيوية ودرجة الغيبوبة ومستوى التروبونين والكرياتينين و الإسعافات الأولية التى تم اتخاذها وتأثير كل ذلك على المريض. نتائج البحث: وجد انه يزداد معدل حدوث التسمم بفوسفيد الألومنيوم كل عام ، في عام 2020 كان 10.9٪ فقط من المرضى الخاضعين للدراسة ، وفي عام 2021 اصبح (25٪) ، بينما في النصف الأول من عام 2022 وصل الى 64.1٪. وقد كان متوسط اعمار الحالات 21.7 ± 10.65 وكان معظمهم من الذكور بنسبة 53.1٪. وكانت هناك زيادة ذات دلالة إحصائية في النسبة المئوية للمرضى الناجين الذين تم اعطائهم زيت البارافين بنسبة (84.6٪) مقارنة بالطرق الأخرى (15.4٪). وتم استخدام تحليل منحنى تشغيل المستقبل لتقييم توقع حدوث وفيات في المرضى المصابين وكان معدل الدقة لكل من الجزء المطرود من مضخة القلب ، درجة شدة التسمم ، الجرعة ، التروبونين ، ضغط الدم الانقباضي ، وقت التأخر لكل ساعة ، ونسبة بيكربونات الصوديوم هو 100٪ ، 97.7٪ ، 94.4٪ ، 93.7٪ ، 89.5٪ ، 81.9٪ ، و 80.1٪ على التوالي مع معدل تمييز ممتاز.وكان التمييز مقبول لكل من ضغط الدم الانبساطي (77.9٪) وغازات الدم (75.2)٪ بينما أعطى الكرياتينين و درجة الغيبوبة تمييزاً غير مقبول. **الخلاصة:** خلصت الدراسة الحالية إلى أن تكرار تناول فوسفيد الألومنيوم بغرض الانتحار في ازدياد مستمركل عام. ووجد ان تناول زيت البارافين والسرعة فى تلقى العلاج لهم تاثير افضل على تطور الحالة. وان تقييم الجزء المطرود من مضخة القلب ودرجة شدة التسمم ونسبة التروبونين والكرياتينين بالدم و ضغط الدم وغازات الدم لهم دور هام فى توقع حدوث الوفيات والحاجة للتدخل العاجل للمرضى ذوى الحالات السيئة.