Comparison of Three Different Scoring Systems in Predicting Mortality Of Acute Aluminum and Zinc Phosphide Poisoned Patients Admitted to ICU at Zagazig University Hospitals

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ABSTRACT

Aluminum and zinc phosphides are effective, cheap and available rodenticides and insecticides known to have high mortality rats. Exposure to these compounds occurs suicidal, accidental or occupational. ***Aim:*** The current work was performed to compare the ability of Sequential Organ Failure Assessment (SOFA) score, Acute Physiology and Chronic Health Evaluation II (APACHE II) score and Simplified Acute Physiology Score II (SAPS II) to predict mortality of acute aluminum and zinc phosphide poisoned patients admitted to ICU. ***Subjects and methods:*** Patients admitted to ICU from January 2015 to December 2015 were included and prospectively followed up till discharge or death where they were divided into survivors and non-survivors groups. The socio-demographic and poisoning data were collected and SOFA, APACHE II and SAPS II scores were calculated during the first twenty four hours post admission. The accuracy of each scoring system was detected using Receiver Operating Characteristic (ROC) curve analysis and standardized mortality ratio (SMR) and by means of Hosmer & Lemeshow goodness-of-fit test. ***Results:*** sixty two patients were enrolled, the overall mortality rate was 30.6%; higher mortality rate was associated with aluminum phosphide, delayed time to ICU admission and with suicidal exposure. SOFA, APACHE II, SAPS II values were significantly higher in non- survivor group. SOFA shows significantly higher AUC 0.981 versus 0.856 for APACHE II and 0.837 for SAPS II, the SMR of SOFA was 1.18. ***Conclusion:*** although SOFA, APACHE II and SAPS II can predict mortality of acute aluminum and zinc phosphide patients admitted to ICU, SOFA score has the highest predictive values beside being easier and simpler.

Keywords: aluminum phosphide, zinc phosphide, SOFA, APACHE II, SAPS II.

INTRODUCTION

Acute pesticide poisoning has become a major public health problem worldwide with more than 300.000 deaths annually and over than 99% of these deaths being from low and middle income countries **(Konradsen, 2007).** Aluminum and zinc phosphide are highly effective pesticides used widely to protect grain in stores and domestically to kill rodents **(El Naggar and El Mahdy, 2011)**. They are highly toxic compound that causes life-threatening complications leading to high mortality rate ranging from 37 to 100% **(Sogut et al., 2011).** Acute poisoning from both compounds may be direct due to ingestion of the salts or indirect through accidental inhalation of phosphine gas generated during use **(Proudfoot, 2009).**

Mechanism of poisoning of aluminum and zinc phosphide after oral ingestion is unclear possibly through formation of phosphine gas in the stomach that is rapidly absorbed leading to inhibition of cytochrome oxidase, impairment of mitochondrial morphology and oxidative respiration **(Bumbrah et al., 2012).** In addition, it is a protoplasmic poison that inhibits various enzymes and protein synthesis **(Acharya et al., 2014).**

There is usually only a short interval between ingestion of phosphides

and the appearance of systemic toxicity; clinical symptoms are hypotension, myocarditis, pericarditis, shock symptoms, congestive heart failure and circulatory collapse. Gastro-intestinal symptoms including nausea, vomiting, diarrhea and abdominal pain also occur **(Gurjar et al., 2011).** Acute liver failure though rare is one of the most dangerous side effects, it occurs because aluminum and zinc phosphide contains inorganic phosphorous which is hepatotoxic and can be lethal in small doses **(Saraf et al., 2015).** Pulmonary edema can also supervene, though whether it is cardiogenic or non-cardiogenic is not always clear **(Sogut et al., 2011).** Severe hypoglycemia, delirium, tonic-clonic convulsions, severe metabolic acidosis with acute distal renal tubular acidosis has been associated with aluminum and zinc phosphide ingestion **(Orak et al., 2008).**

Diagnosis of most cases is based mainly on positive history of exposure, the presence of clinical features, and highly variable arrhythmias with shock and no previous history of cardiac disease **(Masoud et al., 2013)**.

Unfortunately, there is neither an antidote, nor a specific treatment for it (**Doğan et al., 2014).** Since the only way of management is a quick and aggressive supportive therapy, creating a prognostic score for the acute intoxications may have positive impact in the management of patients; as cases in the resuscitation place expected to have a trend towards worsening will be directed directly and after a short period of time to the appropriate facility **(Oprita et al., 2014)**

Predictors of outcome previously reported in aluminum phosphide cases are either clinical predictors or laboratory tests including ECG, cardiac monitoring, blood sugar, chest X-ray, arterial blood gas analysis, serum electrolytes, complete blood count and kidney and liver function **(Hashemi-Domeneh et al., 2016)**

Regarding clinical prognostic markers of severity, they include number of vomiting attacks, degree of hypotension, development of refractory shock, ARDS, aspiration pneumonitis, gastrointestinal bleeding and pericarditis **(Wahab et al., 2008).**

In addition, several scoring system have been applied to cases of aluminum phosphide poisoning. The scoring systems enable the clinician to predict the outcome, stratify risk, assess conditions and diagnose diseases accurately in critically ill patients **(Oprita et al., 2014).**

Poor prognosis of aluminum phosphide acute poisoning cases was associated with high Simplified Acute Physiology Score (SAPS) and Acute Physiology and Chronic Health Evaluation II (APACHE II), and low Glasgow coma scale **(Louriz et al., 2009; Shadnia et al., 2010 and Mathai and Bhanu, 2010).**

However, Sequential organ failure assessment (SOFA) score and which scoring system better predicts mortality in cases of aluminum and zinc phosphide poisoning admitted to ICU have not been previously tested. SOFA system was initially proposed by **Vincent et al. (1996)** aiming to continuously reflecting the dynamic development of multi-organ dysfunction from mild to severe. Although SOFA was developed in assessing sepsis, the scope of this system extends to show good correlation with prognosis of other conditions as stem cell transplantation, burns and poisoning **(Ñamendys-Silva et al., 2009; Lorente et al., 2009 and Kim et al., 2013).**

SOFA scoring system has the advantage of bedside applicability and simplicity using widely available variables **(Vincent et al., 1998 and Ferreira et al., 2001)**.

THE AIM OF THE STUDY

The current work is performed to compare the ability of Sequential Organ Failure Assessment (SOFA) score, Acute Physiology and Chronic Health Evaluation II (APACHE II) score and Simplified Acute Physiology Score II (SAPS II) to

predict mortality of acute aluminum and zinc phosphide poisoned patients admitted to ICU.

SUBJECTS AND METHODS

This work was a longitudinal follow up study that was conducted after approval of the Institutional Review Board of Faculty of Medicine, Zagazig University. An informed consent was obtained from the patient or legally authorized representative for patients unable to give consent.

Methodology:

Study population:

Inclusion criteria:

Adult Cases of acute aluminum or zinc phosphide poisoning admitted to ICU, Zagazig University Hospitals from January 2015 to December 2015 were enrolled in the study.

Diagnosis of acute toxicity was based on history of ingestion of phosphide compounds, based on information about the brand name of the poison; bringing the container and/or the description of characteristics of the poison either by patients or relatives, and clinical presentation of the case. Silver nitrate test was done to help confirming the diagnosis of phosphide poisoning. Five ml of gastric aspirate and 15 ml of water is put in a flask and the mouth of the flask is covered by filter paper impregnated with 0.1N silver nitrate (16.987 gm of silver nitrate in 1L distilled water). The flask is heated at 50^{o}C for 15 to 20 minutes; if phosphine is present the filter paper turns black **(Wahab et al., 2008)**. This test was done in Biochemistry Department, Faculty of Medicine, Zagazig University.

Exclusion criteria:

Cases with severe chronic illnesses as hepatic, cardiovascular, renal or respiratory diseases, patients with uncontrolled diabetes, cases of co-ingestions or unclear history, those with missing data were excluded from the study.

Cases were managed according to the protocol followed up by the toxicology consultants of Zagazig University Poison Control Center; patients were initially resuscitated, gastric decontamination was performed using sodium bicarbonate and coconut oil, mechanical ventilation and vasoactive drugs started whenever indicated, symptomatic and supportive treatment including treatment of acidosis and seizures were instituted, N-acetyl cysteine was also considered as an anti-oxidant.

Demographic data of the patients were recorded including age, gender, residence and poisoning information including type of the poison (aluminum phosphide or zinc phosphide depending on the description of the poison), time elapsed between exposure and presentation, route of exposure and mode of poisoning (suicidal, accidental, homicidal).

In addition, the following parameters were also recorded: Glasgow coma score, vital signs, urine output, Liver function, kidney function test, ABG, Na, K, CBC, Coagulation profile and random blood sugar.

The previous parameters were used to calculate SOFA, APACHE II, SAPS II scores according to the original detailed methodology described by **Vincent et al. (1996)**, **Kanus et al. (1985)** and **Le Gall et al. (1993)** respectively during first day of ICU admission, using the most deranged values for each parameter **(appendix I, II, III)**. The patients were followed till discharge from hospital or death and according to the outcome they were classified into survivors and non-survivors.

Statistical analysis

Statistical analysis was performed where qualitative date are presented as frequency and percentage and quantitative data are presented as mean±SD, comparison between survivors and non-survivors was done using Chi- square test to compare qualitative variables and independent sample *t*-test to compare continuous normally-distributed variables. *P*- value less than 0.05 was considered statistically significant. The accuracy of

each scoring system in prediction of mortality was assessed using calibration and discrimination. Calibration was assessed by comparing the observed mortality to the predicted mortality {standardized mortality ratio (SMR)} and by means of Hosmer & Lemeshow goodness-of-fit test. Discrimination potential was measured by calculating area under the Receiver Operating Characteristic (ROC) curve with 95% confidence interval, area under curve (AUC) more than 0.9 considered outstanding, between 0.8 and 0.9 considered excellent, between 0.7 and 0.8 considered acceptable and less than 0.7 considered poor **(Choi, 1998).**

RESULTS

Sixty eight adult consecutive cases of both sexes were included; six cases were died within the first four hours of admission so they were excluded from the results. The overall mortality rate was 30.6%. The age range of the patients was from 16 to 50 years; there was no significant difference between the survivor group and non-survivor group regarding the age, gender, residence, route of exposure ($p>0.05$). However, mortality was significantly higher among patients with aluminum phosphide poisoning than zinc phosphide poisoning ($p<0.0001$). Mortality was also significantly higher among patients with suicidal exposure rather than accidental exposure ($p<0.05$). In addition, time between exposure and ICU admission in non-survivor group (6.5±2.1) hours was significantly higher than in survivor group (3.6±1.9) hours.

As shown in **Table 2,** the mean values of SOFA, APACHE II and SAPS II scores in the survivor group (3.25±0.97, 33.74±2.83, 36.09±3.61) respectively were significantly lower than non-survivor group (8.15±2.00, 38.47±4.10, 42.21±4.40) respectively; ($p<0.0001$)**.**

Table 3 shows that area under receiver operating characteristic (ROC) curve for SOFA, APACHE II and SAPS II scores were 0.981 (95% CI 0.909-0.999), 0.856 (95% CI 0.743-0.932) and 0.856 (95% CI 0.743-0.932) respectively. The sensitivity was higher for SOFA (94.74; 95% CI 74.0 - 99.9) followed by APACHE II (78.95; 95% CI 54.4-93.9) followed by SAPS II (63.16; 95% CI 38.4 – 83.3) while the specificity was higher for SOFA (90.7; 95% CI 77.9 - 97.4) followed by SAPS II (88.4; 95% CI 74.9 – 96.1) followed by APACHE II (74.42; 95% CI 58.8-86.5). Also, SOFA score has the highest positive and negative predictive values followed by SAPS II followed by APACHE II. **Figure (1)** shows comparison of the ROC curve for SOFA, APACHE II and SAPS II scores.

Pairwise comparison of ROC curves for the three scoring systems shows that AUC for SOFA score is significantly higher than AUC for APACHE II ($p<0.05$) and also significantly higher than AUC for SAPS II score ($p<0.05$). In addition, there was no statistically significant difference between AUC for APACHE II and SAPS II scores ($p>0.05$) as shown in **table 4**.

The SMR for SOFA, APACHE II and SAPS II scores were 1.18 (95% CI 0.736-1.82), 1.72 (95% CI 1.071-2.64) and SAPS II 1.58 (95% CI 0.981-2.42) respectively **(Table 5).**

The results obtained from operating Hosmer & Lemeshow goodness-of-fit test showed chi-square values of 0.215 (p=0.99), 5.08 (p=0.74) and 7.96 (p=0.33) for SOFA, APACHE II and SAPS II respectively indicating that there is no significant difference between predicted and actual mortality.

Table (1): Comparison between survivors and non-survivors aluminum and zinc phosphide cases regarding demographic characteristics and poisoning data:

Group / variables	Survivors n=43		Non-survivors n=19		Total n=62	X^2	*p*-value
Age (mean±SD)	30.7±10.6		26.3±8.9			1.578	0.119
Gender							
- **Male**	7	36.8%	12	63.2%	19 (30.6%)	1.46	0.227
- **Female**	23	53.5%	20	46.5%	43 (69.4%)		
Residence							
- **Rural**	19	38%	31	62%	50(80.6%)	0.579	0.446
- **urban**	6	50%	6	50%	12(19.4%)		
Type of the poison							
- **zinc phosphide**	35	83.3%	7	16.7%	42(67.7%)	11.97	<0.0001*
- **aluminum phosphide**	8	40%	12	60%	20(32.3%)		
Time between exposure and ICU admission (hours)	3.6±1.9		6.5±2.1			-5.36	<0.0001*
Route of exposure							
- **oral**	28	51.9%	26	48.1%	54(87.1%)	3.602	0.057
- **inhalation**	7	87.5%	1	12.5%	8 (12.9%)		
Mode of exposure							
-Suicidal	14	31.8%	30	68.2%	44(70.9%)	6.371	0.011*
-Homicidal	0	0	0	0	0		
-Accidental	12	66.7%	6	33.3%	18(29.1%)		

X2: Chi square ***: Significant (p<0.05)**
n: number **SD: standard deviation**

Table (2): Statistical comparison between survivors and non-survivors regarding SOFA, APACHE II, SAPS II during the first post-ICU admission day using independent sample *t*-test:

Variable	survivors			Non-survivors					
	n	Mean	SD	n	Mean	SD	Difference	95% CI	P
SOFA	43	3.25	0.97	19	8.15	2.00	4.9021	4.14- 5.65	<0.0001*
APACHE II	43	33.74	2.83	19	38.47	4.10	4.7295	2.92- 6.53	<0.0001*
SAPS II	43	36.09	3.61	19	42.21	4.40	6.1175	3.98-8.25	<0.0001*

***: Significant (p<0.05)** **n: number**
SD: standard deviation **CI: confidence interval**

Table (3): Receiver operating characteristic curve (ROC) for SOFA, APATCHE II and SAPS II in 1st post- ICU admission day in differentiation between survivors and non-survivors following acute aluminum and zinc phosphide poisoning:

	AUC 95% CI	Sensitivity 95% CI	Specificity 95% CI	+ve predictive value 95% CI	-ve predictive value 95% CI
SOFA	0.981 (0.909-0.999)	94.74 (74.0 - 99.9)	90.7 (77.9 - 97.4)	81.4 (63.0-91.8)	97.6 (85.6-99.6)
APACHE II	0.856 (0.743-0.932)	78.95 (54.4-93.9)	74.42 (58.8-86.5)	56.9 (43.0-69.8)	89.2 (77.2-95.2)
SAPS II	0.837 (0.743-0.932)	63.16 (38.4 – 83.3)	88.4 (74.9 – 96.1)	70.0 (48.8 - 85.0)	93.4 (75.5 - 91.1)

AUC: area under curve **CI: confidence interval**

Table (4): Pairwise comparison of area under receiver operating characteristic (ROC) for SOFA, APACHE II and SAPS II scores in in 1st post- ICU admission day after acute aluminum and zinc phosphide poisoning:

SOFA ~ SAPS II	
Difference between areas	0.144
95% Confidence Interval	0.0219 to 0.266
Significance level	**P = 0.0207***
SOFA ~ APACHE II	
Difference between areas	0.125
95% Confidence Interval	0.0128 to 0.238
Significance level	**P = 0.0290***
SAPS II ~ APACHE II	
Difference between areas	0.0184
95% Confidence Interval	-0.131 to 0.168
Significance level	**P = 0.8102**

*** Significant (p<0.05)**

Table (5): Standardized mortality ratios for SOFA, APATCHE II and SAPS II in 1st post- ICU admission day after acute aluminum and zinc phosphide poisoning:

	Actual mortality %	Predicted mortality %	SMR	95% CI
SOFA	0.306	0.258	1.18	0.736-1.82
APACHE II	0.306	0.177	1.72	1.071-2.64
SAPS II	0.306	0.193	1.58	0.981-2.42

SMR: standardized mortality ratio **CI: confidence interval**

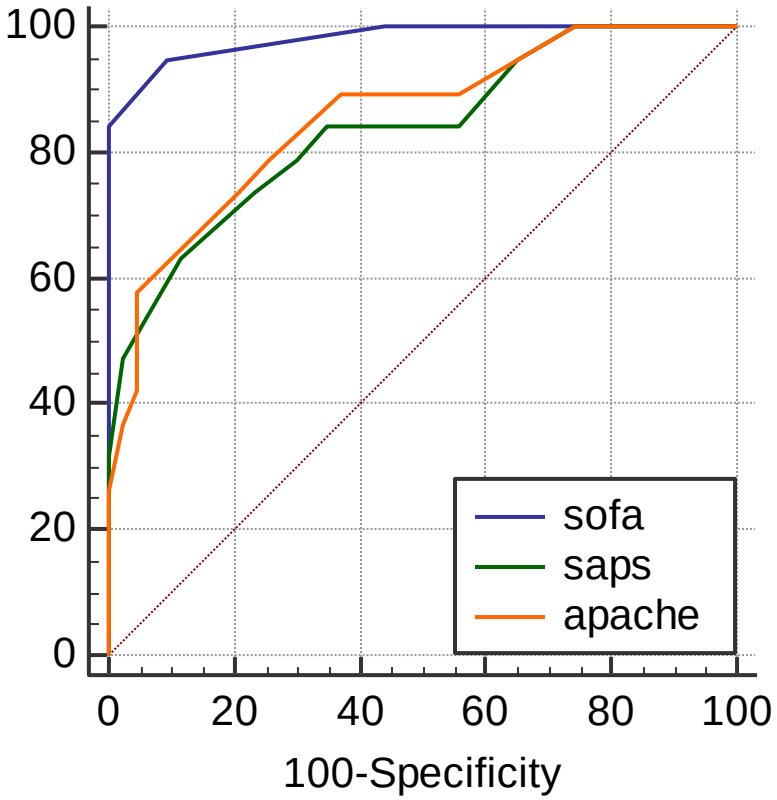

Fig (1): Graph for comparison receiver operating characteristic curve (ROC) for SOFA, APATCHE II and SAPS II in 1st post- ICU admission day following acute aluminum and zinc phosphide poisoning. Area under curve (AUC) for SOFA, APACHE II and SAPS II scores were 0.981, 0.856 and 0.856 respectively. The sensitivity was higher for SOFA (94.74) followed by APACHE II (78.95) followed by SAPS II (63.16); while the specificity was higher for SOFA (90.7) followed by SAPS II (88.4) followed by APACHE II (74.42)

DISCUSSION

Aluminum and zinc phosphide are inexpensive, effective and frequently used pesticides. However, unfortunately, it is now one of the commonest causes of poisoning among farming pesticides. In addition, poisoning by these compounds carries a high mortality rates (Proudfoot, 2009). The aim of the current work was to evaluate the role of SOFA scoring system in predicting mortality of patients with aluminum and zinc phosphide poisoning admitted to ICU and to compare the predictive value of SOFA, APACHE II and SAPS II scoring systems. The patients under the study were divided into survivor group and non- survivor group.

With referral to the socio-demographic characteristics of the studied patients there was no significant difference between the two groups regarding age, gender which is in accordance with the study conducted by **Shadnia et al. (2010).** The current study showed that there is no significant difference in the mortality rate among patients with rural or urban residence and this may be explained by the geographic distribution of the areas served by Zagazig Poison Control Center where there is an easy access to health care from both rural and urban areas. According to **Moghadamnia (2012)**, poisoning by phosphides is more common in rural and

suburban zones mostly due to its availability and use in agriculture.

The current work also documented that there was a significantly higher mortality rate among patients with aluminum phosphide than zinc phosphide poisoning which runs in parallel to **Hashemi-Domeneh et al. (2016).** In addition, the time between exposure and ICU admission was significantly higher in non- survivor group which is in accordance with the study conducted by **Hashemi-Domeneh et al. (2016)** who reported that most deaths occur during the first 24 hours and mostly depend on poisoning severity and the time between exposure and treatment. The results of the present study revealed that there is no significant difference in mortality rate between patients exposed to the poison by ingestion or by inhalation; because the toxicity by phosphides is caused by phosphine gas either through inhalation or exhalation after ingestion where it is produced upon contact with hydrochloric acid in the stomach **(Gurjar et al., 2011)**.

Regarding mode of poisoning, there was a significantly higher mortality between those exposed to the poison for committing suicide rather than accidentally which is in agreement with the study conducted by **Meena et al. (2015)** mostly due to the larger dose to which the victim is exposed. **Moghadamnia (2012)** previously reported that aluminum phosphide is a very common suicidal agent in some eastern countries due to its availability and its known rapid action.

In the current study there was a significant difference between the survivors and non- survivors groups regarding APACHE II scores which runs in parallel to **Louriz et al. (2009) & Mathai and Bhanu (2010).** In addition, there was also a significant difference between the two groups regarding SAPS II score which was also reported by **Shadnia et al., 2010 & Masoud and Barghash (2013) & Inbanathan and Karimungi Rahul (2014).** However, **Mathai and Bhanu (2010)** reported that although the average SAPS II scores were higher in non-survivors group the difference was not significant. The current study has advantages over the previous studies including the relatively larger sample size and the prospective nature of the study.

The current work proved the presence of a significant difference between the survivors and non survivors group regarding SOFA score; adding to that comparison of the AUC, sensitivity, specificity, positive and negative predictive values of the three scoring systems revealed that SOFA score has the highest values. Moreover, pairwise comparison of the AUC for the three scoring systems revealed that SOFA score has a significantly higher AUC when compared to APACHE II and SAPS II score. While there was no significant difference between APACHE II and SAPS II score. Although the current study showed that there is no significant difference between the actual and predicted mortality for the three scoring system, the standardized mortality ratio is nearer to one for the SOFA score denoting better prediction of mortality. Fortunately, the SOFA score is simpler and easier making it a more helpful tool in predicting mortality after acute aluminum and zinc phosphide poisoning.

From the previous discussion we recommend the use of SOFA scoring system as a prognostic indicator in cases of acute aluminum and zinc phosphide poisoning admitted to ICU.

CONCLUSION

We can conclude that although SOFA, APACHE II and SAPS II scoring systems can predict mortality in cases of acute aluminum and zinc phosphide poisoning admitted to ICU, SOFA score has the highest predictive values.

CONFLICTS OF INTEREST

No conflict of interest.

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organ	Criteria	Point Value
Respiration	PaO2/FiO2 (mmHg)	
	<400	+1
	<300	+2
	<200 and mechanically ventilated	+3
	<100 and mechanically ventilated	+4
Coagulation	Platelets (×103/µL)	
	<150	+1
	<100	+2
	<50	+3
	<20	+4
Neurologi.	Glasgow Coma Scale	
	13–14	+1

(Appendix I): SOFA calculator:

	10–12	+2
	6–9	+3
	<6	+4
Liver	Bilirubin (mg/dL) [µmol/L]	
	1.2–1.9 [>20-32]	+1
	2.0–5.9 [33-101]	+2
	6.0–11.9 [102-204]	+3
	>12.0 [>204]	+4
cardiovascular	Mean Arterial Pressure OR administration of vasopressors required	
	No Hypotension	0
	MAP <70 mm/Hg	+1
	dop ≤5 or dob (any dose)	+2
	dop >5 OR epi ≤0.1 OR nor <= 0.1	+3
	dop >15 OR epi >0.1 OR nor >0.1	+4
Renal	Creatinine (mg/dL) [µmol/L] (or urine output)	
	<1.2 [<106]	0
	1.2–1.9 [106-168]	+1
	2.0–3.4 [177-301]	+2
	3.5–4.9 [309-433] (or <500 ml/d)	+3
	>5.0 [>442] (or <200 ml/d)	+4

(Appendix II): Simplified acute physiology score chart (SAPS II):

Parameter	findings	points
Age	<45	0
	46-55	1
	56-65	2
	66-75	3
	>75	4
Systolic blood pressure (mmHg)	>190	4
	150-169	2
	80-149	0
	55-79	2
	<55	4
Heart rate (beat/minute)	>180	4
	140-179	3
	110-139	2
	70-109	0
	55-69	2
	40-54	3
	<40	4
Glasgow coma score	13-15	0
	10-12	1
	7-9	2
	4-6	3
	3	4
Respiratory rate (breaths/min)	>50	4
	35-49	3
	25-34	1
	12-24	0
	10-11	1
	6-9	2
	3-5	3
	<3	4
Body temperature (ºC)	>41	4
	39-40.9	3
	38.5-38.9	1
	36-38.4	0
	34-35.9	1
	32-33.9	2
	30-31.9	3
	<30	4
Urinary output (L/24 hours)	>5	2
	3.5-4.99	1
	0.7-3.49	0
	0.5-0.69	2
	0.2-0.49	3
	<0.2	4
Hematocrit (%)	>60	4
	50-59.9	2

	46-49.9 30-45.9 20-29.9 <20	1 0 2 4
White blood cells count (1000/µl)	>40 20-39.9 15-19.9 3-14.9 1-2.9 <1	3 2 1 0 1 2
Serum glucose (mg/dL)	>800 500-799 250-499 70-249 50-69 29-49 <29	4 3 1 0 2 3 4
Serum potassium (mEq/L)	>7 6-6.9 5.5-5.59 3.5-5.4 3-3.4 2.5-2.9 <2.5	4 3 1 0 1 2 4
Serum sodium (mEq/L)	>180 161-179 156-160 151-155 130-150 120-129 110-119 <110	4 3 2 1 0 2 3 4
Blood urea nitrogen (mg/dL)	>154 101-153 81-100 21-80 10-20 <10	3 2 1 0 1 2
Serum HCO3 (mEq/L)	>40 30-39.9 20-29.9 10-19.9 5-9.9 <5	2 1 0 1 2 3

(Appendix III): APACHE II scoring system:

The APACHE II Severity of Disease Classification System

Physiologic Variable	+4	+3	+2	+1	0	+1	+2	+3	+4
Temperature - rectal (°C)	≥41	39-40.9		38.5-38.9	36-38.4	34-35.9	32-33.9	30-31.9	≤29.9
Mean Arterial Pressure (mm Hg)	≥160	130-159	110-129		70-109		50-69		≤49
Heart Rate	≥180	140-179	110-139		70-109		55-69	40-54	≤39
Respiratory Rate (nonventilated or ventilated)	≥50	35-49		25-34	12-24	10-11	6-9		≤5
Oxygenation (mmHg) a. $FiO_2 > 0,5$ use A-aDO_2 b. $FiO_2 < 0,5$ use PaO_2	a ≥500	350-499	200-349		<200				
	b				> 70	61-70		55-60	<55
Arterial pH	≥7.7	7.6-7.69		7.5-7.59	7.33-7.49		7.25-7.32	7.15-7.24	<7.15
Serum Sodium (mmol/l)	≥180	160-179	155-159	150-154	130-149		120-129	111-119	≤110
Serum Potassium (mmol/l)	≥7	6-6.9		5.5-5.9	3.5-5.4	3-3.4	2.5-2.9		<2.5
Serum Creatinine (mg/dl, Double point score for acute renal failure)	≥3.5	2-3.4	1.5-1.9		0.6-1.4		<0.6		
Hematocrit (%)	≥60		50-59.9	46-49.9	30-45.9		20-29.9		<20
White Blood Count (in 1000/mm³)	≥40		20-39.9	15-19.9	3-14.9		1-2.9		<1
Glasgow-Coma-Scale (GCS)	Score = 15 minus actual GCS								
Serum HCO_3 (venous, mmol/l, use if no ABGs)	≥52	41-51.9		32-40.9	22-31.9		18-21.9	15-17.9	<15
A = Total Acute Physiology Score APS	Sum of the 12 individual variable points								

B = Age Points		**C = Chronic Health Points**
≤44 years	0 points	If the patient has a history of severe organ system insufficiency or is immunocompromised assign points as follows:
45-54 years	2 points	a. For nonoperative or emergency postoperative patients – 5 points
55-64 years	3 points	b. For elective postoperative patients – 2 points
65-74 years	5 points	
≥75 years	6 points	

APACHE II Score = Sum of A (APS points) + B (Age points) + C (Chronic Health points)

(From: Knaus WA, Draper EA, Wagner DP, Zimmerman JE. APACHE II: a severity of disease classification system. Crit Care Med 1985;13(10):818-29)

الملخص العربي

مقارنة بين ثلاثة أنظمة تقييم مختلفة في التنبؤ بالوفيات بين مرضي تسمم الألمونيوم والزنك فوسفيد الحاد المحجوزين بالعناية المركزة بمستشفيات جامعة الزقازيق

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يعتبر الألومنيوم و الزنك فوسفيد من مبيدات الحشرات والقوارض الفعالة والرخيصة والمتاحة والمعروفة بنسبة الوفيات العالية وذلك نظرا لخطورتها. يتم التعرض للألومنيوم والزنك فوسفيد إما عمدا بهدف الانتحار او عن طريق الخطأ أو من خلال التعرض المهني.

وقد أجريت هذه الدراسة بهدف مقارنة نظام السوفا التقييمي ونظام الاباتشى2والسابس2 في التنبؤ بالوفيات بين مرضي تسمم الألمونيوم والزنك فوسفيد الحاد المحجوزين بالعناية المركزة.

وقد شملت هذه الدراسة مرضي تسمم الألومنيوم والزنك فوسفيد الحاد المحجوزين بالعناية المركزة بمستشفيات جامعة الزقازيق في الفترة من يناير 2015 وحتي ديسمبر 2015 حيث تم متابعة هذه الحالات حتي تحسنها وخروجها أو حدوث الوفاة حيث تم تقسيم الحالات الي ناجين وغير ناجين. وقد تم جمع البيانات الاجتماعية والديموغرافية وبيانات التسمم الخاصة بالحالات وحساب السوفا والاباتشي 2 والسابس 2 لكل الحالات في خلال الاربع والعشرين ساعة الأولي من حجزهم بالعناية المركزة ومقارنة القيم التنبؤية لكل نظام إحصائيا.

وقد شملت الدراسة اثنين وستين حالة وبلغت نسبة الوفيات 30.6% و أظهرت النتائج وجود ارتفاع ذو دلالة إحصائية في نسبة الوفيات بين مرضي التسمم بالألومنيوم فوسفيد مقارنة بالزنك فوسفيد و كذلك بين المرضي المتعرضين للمادة السامة عن طريق الانتحار مقارنة بالتعرض عن طريق الخطأ. بالإضافة لذلك فقد وجد ان عدد الساعات التي مرت بين تعرض المريض للمادة السامة واحتجازه بالعناية المركزة أعلي في مجموعة الغير ناجين عنها في مجموعة الناجين.

وقد أظهرت النتائج ايضا ارتفاع ذو دلالة إحصائية في قيم السوفا والاباتشي2 والسابس 2 في مجموعة الغير ناجين مقارنة بمجموعة الناجين.

وأظهر التحليل الإحصائي للأنظمة الثلاثة أنه بالرغم من قدرة الأنظمة الثلاثة علي التنبؤ بالوفيات في هذه الحالات الا ان نظام السوفا هو الأقدر علي التنبؤ بالوفيات بالإضافة الي كونه ابسط وأسهل ومن ثم ننصح باستخدام نظام السوفا في تقييم حالات تسمم الألومنيوم والزنك فوسفيد الحادة.