Original Article

Clinical and Laboratory Predictors of Acute Poisoning Mortality among Intensive Care Unit Patients, With Special Consideration to New-Poisoning Mortality Score

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ABSTRACT

Background: Emergency department visits for acute poisoning are increasing and often need intensive care unit (ICU) treatment. **Aim**: Evaluating the role of clinical and laboratory characteristics of acute poisoning patients admitted to ICU in predicting mortality with special consideration to new poisoning mortality score.

Patients and Methods: A cross-sectional study was conducted on ninety acute intoxication patients aged 18 years old and above of both sexes, admitted to ICU in Sohag University Hospitals. Demographic, toxicological data, vital signs, GCS, New-poisoning mortality score (NPMS), poisoning severity score (PPS), laboratory investigations such as arterial blood gases, liver and kidney functions, and CBC were recorded and related to the patient's outcome**. Results:** Results showed that 62.22% of patients were in the 20-40 age range, females were 61.11% and suicide rate was 82.22%. Aluminum phosphide, organophosphorus, and antipsychotics were the most common toxic agents in the study. The mortality was 33.33%. Regarding the clinical and laboratory characteristics, systolic and diastolic blood pressure, oxygen saturation, need for mechanical ventilation, PH, HCO_3, Na, Ca, ALT, AST, creatinine, WBCs, and platelets counts showed a significant difference between survivors and non-survivors. The cutoff points for mortality prediction by new-PMS, PSS, and GCS were ≥ 56, ≥ 2, and < 8 with a sensitivity of 88.33% for all, specificities of 80 %, 96.67%, and.70 %, and accuracy of 89.8%, 92.6%, and 81.6% respectively. **Conclusion:** Using toxicological data, routine laboratory analysis, vital signs, and GCS on admission can predict acutely poisoned patients' outcomes. **Recommendations:** It is critical to raise public knowledge about the dangers of aluminum phosphide and organophosphorus poisons, as these were the most prevalent hazardous compounds studied. The new poisoning mortality score is a simple, quick, and simply applied technique for predicting acute poisoning mortality

Keywords: Predictors**,** Mortality, Scoring systems, New- PMS, Intensive Care Unit.

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I. INTRODUCTION

Acute intoxication is a serious health problem that causes significant mortalities and morbidities worldwide. Minimizing in-hospital mortality and allocating the resources of health care need early diagnosis, severity evaluation, and accurate care in emergency departments (ED) and intensive care units (ICU) (Torky et al., 2023).

The prevalence of poisoning is rising as a result of alterations in social behavior and lifestyle, as well as contemporary technological advancements and community development (Getie and Belayneh, 2020). The general public is in daily danger of poisoning due to the easy access to pharmaceuticals, chemicals, and natural toxins in many nations (Sabahi et al., 2021).

According to Boedeker et al. (2020), a lack of hospital resources and a rise in pesticide poisoning are the main reasons why the bulk of fatal cases occur in developing countries. About 40% of patients who enter the ED suffering from poisoning end up being admitted to the hospital and up to 1.5–3.7% of poisoning patients require admission to the ICU (Brandenburg et al., 2017).

The amount and type of toxic agent, the route of intoxication, the co-ingestion of medications, and co-morbidities existence are some of the factors that determine acute poisoning patients' reasons for ICU admission, treatment options, and complications. Critical care interventions include airway protection, the requirement for hemodynamic stabilization, mechanical ventilation, vasopressor needs, and particular methods to improve the elimination of various toxins (Sulaj et al., 2015). Kocaşaban et al. (2019) said that a patient was admitted to ICU if he met at least one of the following criteria: Glasgow coma scale (GCS) less than 15, bradycardia or tachycardia, hypotension, high level of lactate, and alkaline or acidic PH.

Prediction of outcomes in patients with acute poisoning helps in timely and proper treatment. Patients' mortality relies on their physiological features and specific criteria of the poisoning as substance type, exposure route, and intent of poisoning (Cheung et al., 2018 & Han et al., 2021).

Several scoring systems can be used in acute poisoning patients, to predict mortality as using a system of APACHE II, SAPS II, and SOFA in the ICU (Dorooshi et al.,2023).

Recently, Han et al. (2021) developed a new Poisoning Mortality Score (PMS) for predicting the probability of mortality in cases of acute poisoning. New PMS is a simple and easily used system for clinical practice. It consists of ten predictors, including the patient's demographics initial vital signs, and poisoning-related factors. The study's aim was to evaluate the clinical and laboratory characteristics of patients with acute poisoning admitted to ICU and the possibility of using them as predictors of mortality with special consideration to the role of the new-poisoning mortality score.

II. Patients & Methods

Type of the study:

The study was cross-sectional and conducted on 90 acutely intoxicated patients aged 18 years old and above of both sexes, admitted to ICU in Sohag University Hospitals. The study consists of two parts: A retrospective part that involved only one year from January 2023 to December 2023 and a prospective part that involved 4 months from the first of January 2024 to the end of April 2024.

Patients:

1- Retrospective part: files of ICU patients in Sohag University Hospitals were revised to select all acutely intoxicated patients who fulfilled the inclusion criteria during a period from January 2023 to December 2023).
2- Prospective part: Patients with acute poisoning presented to the ICU in Sohag University Hospitals during a specific period from January 2024 to April 2024 were evaluated clinically and laboratory.

Inclusion criteria:

- Acutely intoxicated patients both males and females 18 years old and above presented to the ICU in Sohag University Hospitals in the specified period.

Exclusion criteria:

- Patients with a history of co-ingestion and those with any condition or disease that may change vital signs and laboratory results.

Tools of the study:

The sociodemographic and intoxication data were collected, and laboratory investigations were collected from files of patients in the retrospective part of the study. Regarding patients in the prospective part of the study, Physical examination including the general and systemic part was done. Vital signs and Glasgow coma scale (GCS) (3-15 points) at the time of admission were assessed and recorded. Blood samples were taken from the patients at admission time under complete aseptic precaution for laboratory investigations that included, CBC, serum creatinine, ALT, AST, electrolytes, and arterial blood gases. According to Persson et al. (1998), poisoning severity score (PSS) was measured for all patients in the study. Grading was described as grade (0): no signs or symptoms of poisoning, grade (1): transient, mild or spontaneously resolving symptoms, grade (2): Moderate, or prolonged symptoms, grade (3): Severe or life-threatening symptoms and grade (4): Death. New-Poisoning Mortality Score is a simple score that was developed to evaluate the probability of mortality in cases of acute poisoning was applied to all cases included in the study at the time of admission. The new PMS consists of 10 variables (age, sex, type of substance, route, intent of poisoning, HR, SBP, RR, body temperature, and AVPU scale). New-PMS was the sum of each variable point. The possible new-PMS range was 0 to 137 points (Han et al., 2021).

Statistical analysis:

The data that was collected was coded, tabulated, and analyzed using SPSS software version 25 software. Regarding descriptive statistics, Shapiro-Wilk's test was applied to assess the normal distribution of continuous data. For parametric numerical data, mean, standard deviation, and range were used, while median and Interquartile range (IQR) were applied for non-parametric numerical data. Student t-test, Chi-Square test, and Mann-Whitney test (U test) were used for comparison between the survived and non-survived patients. Also, the ROC Curve (receiver operating characteristic) was performed. P value < 0.05 indicated statistical significance.

Ethical conditions: -

Ethical approval was gained from the Medical Research Ethics Committee of Faculty of Medicine - Sohag University, according to the commitment standard operating procedure guidelines. Under IRB Registration number: Soh-Med-23-11-14PD. In the prospective part of the study, informed consent was gained from all patients or their relatives if the patient had disturbed consciousness before participation.

III. Results

During the study period, 90 patients were hospitalized in the Sohag Intensive Care Unit (ICU), with 30 dying. The mortality rate was 33.33 percent, as demonstrated in (Figure 1).

Sociodemographic data:

The current study included patients between 18 to 80 years of age group. About (25.5%) of the cases were less than 20 years old, and about (62.2%) were between 20 to 40 years old, but only (12.2%) were more than 40 years. Females were more than males (61.1%, and 38.9% respectively). There were 54.4% from rural areas and 45.5% were from urban areas.

The age group 20- 40 years showed the highest incidence among survivors and non-survivors (63.3%, 60%). Cases below 20 years showed about 28% among survivors and 20% among mortalities. The above 40 age group revealed 20% of mortalities and only 8% among survivors. This study revealed no significant statistical differences in all the sociodemographic data (age, sex, residence) regarding survivors and non-survivors (P= 0.067, 0.285, 0.231 respectively) as shown in (Table 1).

Delay time and hospital stay:

Table (2) revealed that the mean value of the delay time (the time between poisoning exposure and treatment) was 3.556 ± 1.515. When comparing survivors to non-survivors, there was a statistically significant reduction in the delay time (P <0.001).

The mean value of hospital stays in the present study was 2.614 ± 1.373. When comparing survivors to non-survivors, there was a statistically significant increase in hospital stays (p=0.005).

Mode of poisoning:

Table (2) showed that suicidal attempts were greater than accidental cases at 82.2%, and 17.7% respectively with survivors and non-survivors not differing P=0.845).

Route of administration:

About 94.4% of cases ingested the poison, followed by inhalational poisoning at 4.4%, followed by dermal exposure at 1.1% with no statistical difference between survivors and non-survivors (p=0.273) as in (Table 2).

Advanced treatment:

According to the current study, approximately 35.5% of cases required mechanical breathing, and survivors' ventilator requirements were statistically significantly lower than those of non-survivors ($p=<0.001$).

In 2.22% of patients, hemodialysis was not necessary, and there was no statistically significant difference between survivors and non-survivors ($p=0.613$) as in (Table 2).

There were 21 types of toxic agents detected in this study. Table (3) shows that the most common three toxic substances in patients admitted to the intensive care unit were aluminum phosphide (26 cases of whom 14 cases died), organophosphorus (20 cases of whom 7 cases died), and antipsychotics (8 cases of whom only one case died). The only substances that demonstrated statistically significant differences between survivors and non-survivors were aluminum phosphide and carbon monoxide (CO poisoning) (p= 0.009, 0.043 respectively). Only organophosphorus (40.63%) and CO poisoning (6.25%) showed a statistically significant difference in the need for mechanical ventilation (P=0.002, 0.054 respectively) as illustrated in (Table 4).

Vital data on admission:

In terms of pulse, there were no significant statistical differences between survivors and non-survivors ($p=0.115$).

Comparing survivors with non-survivors regarding systole and diastole there was a significant statistical decrease (P=0.002, 0.016 respectively). Temperature and respiratory rate did not differ statistically between survivors and non-survivors (p=0.062, 1.000, respectively) as illustrated in (Table 5).

1) **Arterial blood gases and Electrolytes:**

The mean arterial blood gas levels in non-survivors (7.199 ± 0.197) were found to be more acidotic than those in survivors (7.330 ± 0.076) which was considered a significant difference between the two groups.

The mean values of PCO_2 in survivors (40.787 ± 12.586 mmHg) were higher than in non-survivors (37.853 ± 13.138 mmHg) with their differences not being statistically significant ($p=0.307$). Lower mean values in bicarbonate in non-survivors (16.579 ± 7.330 mEq/L) than in survivors (22.155 ± 4.059 mEq/L), comparing the two groups, there were noteworthy statistically significant differences (p= <0.001). PO_2 in survivors showed higher non-significant ($p=0.681$) mean values (70.530 ± 20.180 mmHg) than in non-survivors (68.493 ± 25.493 mmHg). When comparing the mean oxygen saturation values of survivors and non-survivors, there was a statistically significant decline (P= <0.001).

The mean values of oxygen saturation in survivors (91.117 ± 10.777) were higher than that of the non-survivors (75.333 ± 16.147). Survivors and non-survivors had normal mean values in serum potassium (3.835 ± 0.427, 4.062 ± 1.285 respectively).

There was a significant statistical difference in the mean values of serum calcium and sodium in both groups (p=0.001 and 0.004 for calcium and sodium). Compared to survivors (133.462 ± 5.717), non-survivors had mean serum sodium concentrations of 129.233 ± 7.650, which were lower. Serum calcium mean levels in non-survivors were higher (1.821 ± 0.850) than in survivors (1.316 ± 0.476). As seen in (Table 5), there were statistically significant differences (P=0.001) between the two groups regarding the high serum creatinine levels seen in non-survivors (1.912 ± 1.181 mg/dl) and survivors (0.771 ± 0.280 mg/dl). Table (5) showed that white blood cells showed a statistically significant increase in mean values of non-survivors (18.861 ± 12.985) compared to survivors (12.047 ± 3.197) p value= <0.001. In contrast, red blood cells showed no statistically significant difference in mean values of non-survivors (4.904 ± 0.531) compared to survivors (4.820± 0.679) p value= 0.552. Mean values of platelets in survivors were higher than in non-survivors (314.767 ± 57.229, 283.767 ± 45.226) exhibiting a statistically significant variation between the two groups (P= 0.011).

Table (6) revealed a high inter-quartile range was detected in the median values of liver enzymes (ALT and AST) in the non-survivors when compared to the survivors (200 IU (61- 260), 20 IU (14- 27.5)) and (300 IU (50- 400), 21.5 IU (17-30)) respectively. Mann- Whitney Test revealed a significant statistical increase in median values of ALT and AST among non-survivors compared to survivors (p=0.001).

The study highlights the Glasgow coma scale's applicability and importance (GCS), Poisoning severity score (PSS), and New- Poisoning Mortality Score (New-PMS) among studied patients about the patient's outcome. Table (7) and Figure (2) shows that GCS patients with mean values of 11.865 ± 2.548 were survivors while those with mean values of 7.033 ± 4.247 were non-survivors Regarding PSS patients showed mean values of 2.050 ± 0.429 were survivors while 2.967 ±0.183 were non-survivors. The NPMS showed that the mean values in survivors (41.383 ± 10.332) were lower than in non-survivors (60.367 ± 10.607). Between the two groups, every examined score was significant (p=<0.001).

The study groups' most significant predictor of mortality, as shown by a logistic regression evaluation of the predictors, was the use of PSS (OR= 203.181, 95% C.I. between 23.810- 1733.802 P<0.001), followed by increased delay time (OR= 2.278, 95% C.I. between 1.572- 3.302 P<0.001), then New-PMS (OR= 1.167, 95% C.I. between 1.097- 1.242, P<0.001), followed by GCS (OR= 0.675, 95% C.I. between 0.571- 0.797, P<0.001), then mechanically ventilated patients (OR= 0.038, 95% C.I. between 0.012- 0.123 P<0.001), finally Acidotic PH (OR= 0.001, 95% C.I. between 0.000- 0.045 P= 0.001) look at (Table 8).

Table (9) displays that delay time, PSS, New-PMS, Ca, ALT, AST, creatinine, and WBCs correlate significantly with the outcome of intoxicated patients admitted to the ICU (P<0.001 for all except for AST was equal to 0.032). Also, mechanical ventilation, period of hospital stays, systole, diastole, oxygen saturation, GCS, PH, HCO3, sodium, and platelets correlate significantly with the outcome in the ICU (p=0.001, 0.005, 0.002, 0.016, 0.001, 0.001, 0.001, 0.001, 0.004, 0.011 respectively).

Figure (3) and Table (10) Predicting mortality using the Receiver's Operating Characteristics (ROC) graph using Poisoning severity score was the most accurate score in this study with AUC of 0.926, at point of ≥ 2, sensitivity is 88.33 %, specificity 96.67%, PPV 98.1 %, NPV 80.6%, accuracy 92.6%. Following the New Poisoning Mortality Score: AUC was 0.898, at a point of ≥ 56, sensitivity is 88.33 %, specificity 80%, PPV 98.1%, NPV 77.4%, accuracy 89.8%. Finally, the Glasgow Coma Score with an AUC was 0.816%, at a point of < 8 sensitivity was 88.33 %, specificity 70%, PPV was 85.5%, NPV 75%, and accuracy 81.6%.

Table (1): Significance of the socio-demographic data for the outcome in acutely intoxicated patients admitted to ICU in Sohag University Hospitals from January 2023 to April 2024

Sociodemographic data		Outcome						Independent T-Test	
		Survived		Non-Survived		Total		t	P-value
Age	Mean ±SD	26.333 ± 11.602		31.367±13.221		28.011±12.324		-1.851	0.067
Chi-Square		N	%	N	%	N	%	X^2	P-value
Age groups	<20 Years	17	28.33	6	20.00	23	25.56	2.806	0.246
	20-40 Years	38	63.33	18	60.00	56	62.22		
	>40 Years	5	8.33	6	20.00	11	12.22		
Sex	Male	21	35.00	14	46.67	35	38.89	1.145	0.285
	Female	39	65.00	16	53.33	55	61.11		
Residence	Urban	30	50.00	11	36.67	41	45.56	1.434	0.231
	Rural	30	50.00	19	63.33	49	54.44		

Number of patients= 90, χ 2 =chi squared test, Independent T- test= student test, SD= Standard deviation, P significant <0.05, ICU: Intensive Care Unit.

Table (2): History information and the applied advanced treatment modes for survivors and non-survivors in acutely intoxicated patients admitted to ICU in Sohag University Hospitals from January 2023 to April 2024

Characteristics		Outcome Mean ±SD						Independent T-Test	
		Survived		Non-Survived		Total		t	P-value
Delay time (Hours)		3.000±1.235		4.667±1.422		3.556±1.515		-5.735	<0.001*
Hospital stay (Days)		2.900±1.217		2.042±1.504		2.614±1.373		2.911	0.005*
Chi-Square		N	%	N	%	N	%	X^2	P-value
Mode of poisoning	Suicidal	49	81.67	25	83.33	74	82.22	0.038	0.845
	Accidental	11	18.33	5	16.67	16	17.78		
Route	Oral	58	96.67	27	90.00	85	94.44	2.594	0.273
	Inhalation	2	3.33	2	6.67	4	4.44		
	Dermal	0	0.00	1	3.33	1	1.11		
Mechanically ventilated	MV	8	13.33	24	80.00	32	35.56	38.793	<0.001*
	Non-MV	52	86.67	6	20.00	58	64.44		
Hemodialysis	Hemodialysis	1	1.67	1	3.33	2	2.22	0.256	0.613
	Non-Hemodialysis	59	98.33	29	96.67	88	97.78		

Number of patients= 90, $\chi 2$ =chi squared test, Independent T-Test = student test, SD= Standard deviation, P significant <0.05, ICU: Intensive Care Unit, MV= mechanical ventilation.

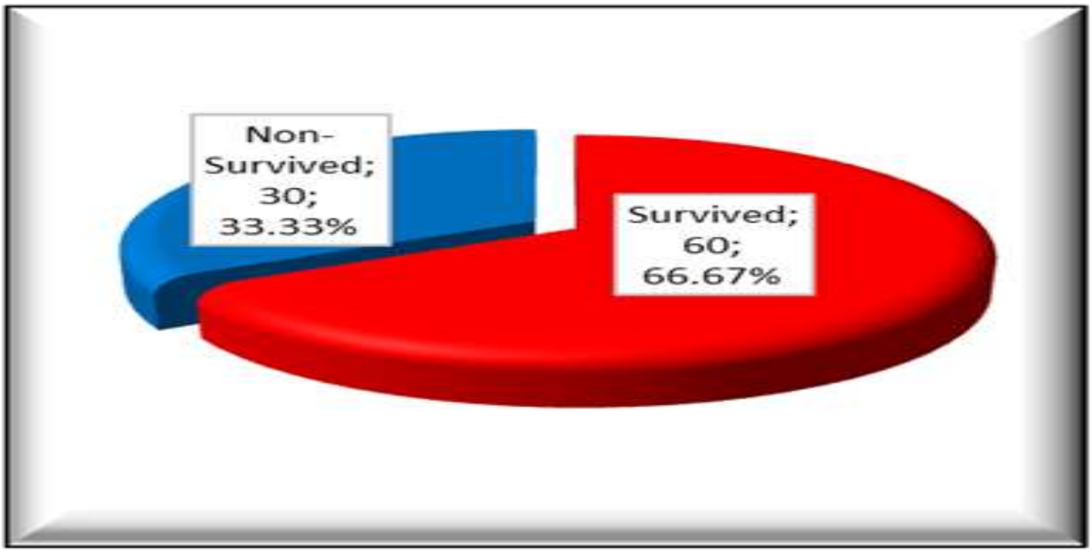

Figure (1): Percentage of Survivors and non-survivors in acutely intoxicated patients admitted to ICU in Sohag University Hospitals from January 2023 to April 2024.

Table (3): Poisoning agents and their relation to the patient outcome in acutely intoxicated patients admitted to ICU in Sohag University Hospitals from January 2023 to April 2024

Toxic agents	Outcome						Chi-Square	
	Survived		Non-Survived		Total			
	N	%	N	%	N	%	X^2	P-value
Antipsychotic	7	11.67	1	3.33	8	8.89	1.715	0.190
Benzodiazepine	4	6.67	0	0.00	4	4.44	2.093	0.148
Morphine	1	1.67	1	3.33	2	2.22	0.256	0.613
Aluminum phosphide	12	20.00	14	46.67	26	28.89	6.923	0.009*
Organophosphorus	13	21.67	7	23.33	20	22.22	0.032	0.858
Anticonvulsant	3	5.00	1	3.33	4	4.44	0.131	0.718
Theophylline	1	1.67	0	0.00	1	1.11	0.506	0.477
Tramadol	1	1.67	1	3.33	2	2.22	0.256	0.613
Corrosive	1	1.67	0	0.00	1	1.11	0.506	0.477
Scorpion	0	0.00	1	3.33	1	1.11	2.022	0.155
Digoxin	1	1.67	1	3.33	2	2.22	0.256	0.613
PPD	2	3.33	1	3.33	3	3.33	0.000	1.000
Carbon monoxide	0	0.00	2	6.67	2	2.22	4.091	0.043*
Chlorine	1	1.67	0	0.00	1	1.11	0.506	0.477
Beta-blocker	2	3.33	0	0.00	2	2.22	1.023	0.312
Oral hypoglycemic	2	3.33	0	0.00	2	2.22	1.023	0.312
Ca channel blocker	1	1.67	0	0.00	1	1.11	0.506	0.477
Carbamate	3	5.00	0	0.00	3	3.33	1.552	0.213
Antidepressant	3	5.00	0	0.00	3	3.33	1.552	0.213
Lithium	1	1.67	0	0.00	1	1.11	0.506	0.477
Methamphetamine	1	1.67	0	0.00	1	1.11	0.506	0.477

N: Number of patients, $\chi 2$ =chi squared test; P significant <0.05, PPD= Para phenylene diamine

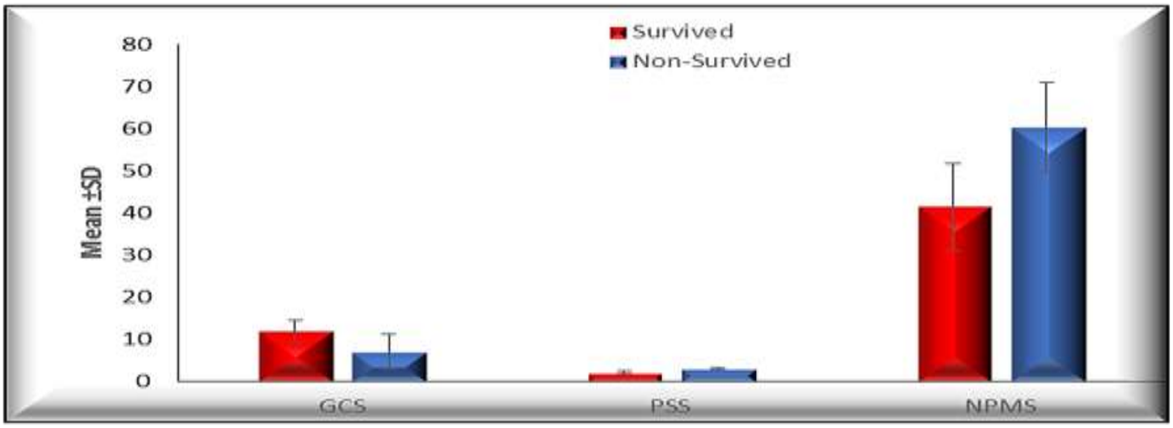

Figure (2): Mean value of the patient's outcome regarding Glasgow coma scale, Poisoning severity score, and new poisoning mortality score in acutely intoxicated patients admitted to ICU in Sohag University Hospitals from January 2023 to April 2024.

Table (4): Poisoning agents and their relation to Mechanical ventilation in acutely intoxicated patients admitted to ICU in Sohag University Hospitals from January 2023 to April 2024

Toxic agents	Mechanically ventilated						Chi-Square	
	MV		Non-MV		Total			
	N	%	N	%	N	%	X^2	P-value
Antipsychotic	1	3.13	7	12.07	8	8.89	2.037	0.154
Benzodiazepine	0	0.00	4	6.90	4	4.44	2.310	0.129
Morphine	1	3.13	1	1.72	2	2.22	0.186	0.666
Aluminum phosphide	11	34.38	15	25.86	26	28.89	0.727	0.394
Organophosphorus	13	40.63	7	12.07	20	22.22	9.729	0.002*
Anticonvulsant	1	3.13	3	5.17	4	4.44	0.204	0.652
Theophylline	1	3.13	0	0.00	1	1.11	1.833	0.176
Tramadol	1	3.13	1	1.72	2	2.22	0.186	0.666
Corrosive	0	0.00	1	1.72	1	1.11	0.558	0.455
Scorpion	0	0.00	1	1.72	1	1.11	0.558	0.455
Digoxin	0	0.00	2	3.45	2	2.22	1.129	0.288
PPD	0	0.00	3	5.17	3	3.33	1.712	0.191
Carbon monoxide	2	6.25	0	0.00	2	2.22	3.707	0.054*
Chlorine	0	0.00	1	1.72	1	1.11	0.558	0.455
Beta-blocker	0	0.00	2	3.45	2	2.22	1.129	0.288
Oral hypoglycemic	0	0.00	2	3.45	2	2.22	1.129	0.288
Ca channel blocker	0	0.00	1	1.72	1	1.11	0.558	0.455
Carbamate	0	0.00	3	5.17	3	3.33	1.712	0.191
Antidepressant	1	3.13	2	3.45	3	3.33	0.007	0.935
Lithium	0	0.00	1	1.72	1	1.11	0.558	0.455
Methamphetamine	0	0.00	1	1.72	1	1.11	0.558	0.455

N: Number of patients, $\chi 2$ =chi squared test, P significant <0.05, MV: Mechanical ventilation, PPD= Para phenylene diamine.

Table (5): Relation between the vital data on admission and initial laboratory parameters with outcome in acutely intoxicated patients admitted to ICU in Sohag University Hospitals from January 2023 to April 2024

Variables	Outcome Mean ±SD			Independent T-Test	
	Survived	Non-Survived	Total	t	P-value
Pulse	102.617±24.160	111.700±28.060	105.644±25.730	-1.592	0.115
Systole	104.000±20.186	90.000±18.937	99.333±20.761	3.165	0.002*
Diastole	65.350±13.557	57.333±16.595	62.678±15.034	2.451	0.016*
Temperature	36.925±0.656	36.617±0.858	36.822±0.739	1.892	0.062
Respiratory rate	23.033±6.755	23.033±11.684	23.033±8.645	0.000	1.000
Oxygen saturation	91.117±10.777	75.333±16.147	85.856±14.762	5.515	<0.001*
PH	7.330±0.076	7.199±0.197	7.286±0.143	4.518	<0.001*
CO2	40.787±12.586	37.853±13.138	39.809±12.774	1.027	0.307
HCO3	22.155±4.059	16.579±7.330	20.296±5.951	4.650	<0.001*
PO2	70.530±20.180	68.493±25.493	69.851±21.970	0.413	0.681
Na	133.462±5.717	129.233±7.650	132.052±6.690	2.946	0.004*
K	3.835±0.427	4.062±1.285	3.911±0.819	-1.248	0.215
Ca	1.316±0.476	1.821±0.850	1.484±0.666	-3.620	<0.001*
Cr	0.771±0.280	1.912±1.181	1.151±0.894	-7.125	<0.001*
WBCs	12.047±3.197	18.861±12.985	14.318±8.494	-3.857	<0.001*
RBCs	4.820±0.679	4.904±0.531	4.848±0.632	-0.597	0.552
Platelets	314.767±57.229	283.767±45.226	304.433±55.259	2.588	0.011*

Number of patients= 90, PH: Power of hydrogen, PO_2: Partial oxygen pressure, PCO_2: Partial carbon dioxide pressure, HCO_3: Serum bicarbonate, Na+: Serum sodium, K+: Serum potassium, Ca+: serum calcium, Cr.: Serum creatinine, WBCs: White blood cells, RBCs: Red blood cells. Independent T-test=student test.

Table (6): Range of the patient liver enzymes concerning the outcome in acutely intoxicated patients admitted to ICU in Sohag University Hospitals from January 2023 to April 2024

Liver Enzymes		Outcome			Mann-Whitney Test	
		Survived	Non-Survived	Total	Z	P-value
ALT	Range	7-654	22-966	7-966	6.778	<0.001*
	Median (IQR)	20 (14-27.5)	200 (61-260)	25 (18-92)		
AST	Range	13-2697	16-6781	13-6781	6.333	<0.001*
	Median (IQR)	21.5 (17-30)	300 (56-400)	30 (19-82)		

Number of patients= 90, AST: Aspartate transaminase, ALT: Alanine transaminase, IQR: Inter Quartile Range.

Table (7): Range and significance of GCS, PSS, and NPMS about the patient's outcome in acutely intoxicated patients admitted to ICU in Sohag University Hospitals from January 2023 to April 2024.

Score	Outcome Mean ±SD			Independent T-Test	
	Survived	Non-Survived	Total	T	P-value
GCS	11.867±2.548	7.033±4.247	10.256±3.928	6.737	<0.001*
PSS	2.050±0.429	2.967±0.183	2.356±0.567	-11.187	<0.001*
NPMS	41.383±10.332	60.367±10.607	47.711±13.726	-8.145	<0.001*

GCS: Glasgow coma scale, PSS= Poisoning Severity Score, NPMS: New Poisoning Mortality Score, Independent T-test: student test, SD: Standard deviation, P significant <0.05

Table (8): Logistic regression analysis of the predictors of mortality in acutely intoxicated patients admitted to ICU in Sohag University Hospitals from January 2023 to April 2024

Predictors of mortality	Odds ratio	95% C.I. for Odds ratio		P value
		Lower	Upper	
Mechanically ventilated	0.038	0.012	0.123	<0.001*
Delay time (Hours)	2.278	1.572	3.302	<0.001*
GCS	0.675	0.571	0.797	<0.001*
PSS	203.181	23.810	1733.802	<0.001*
NPMS	1.167	1.097	1.242	<0.001*
PH	0.001	0.000	0.045	0.001*

Number of patients= 90, C.I: confidence interval, P significant <0.05, GCS: Glasgow coma scale, PSS= Poisoning Severity Score, NPMS: New Mortality Poisoning Score, PH: Power of hydrogen.

Table (9): Correlation coefficient of different parameters as a predictor of the outcome in acutely intoxicated patients admitted to ICU in Sohag University Hospitals from January 2023 to April 2024

Predictors of the outcome	Unstandardized Coefficients		Standardized Coefficients	t	P-value
	B	Std. Error	Beta		
Mechanically ventilated	-0.647	0.079	-0.657	-8.165	<0.001*
Delay time (Hours)	0.163	0.028	0.522	5.735	<0.001*
Hospital stays (Days)	-0.102	0.035	-0.296	-2.911	0.005*
Systole	-0.007	0.002	-0.320	-3.165	0.002*
Diastole	-0.008	0.003	-0.253	-2.451	0.016*
Oxygen saturation	-0.016	0.003	-0.507	-5.515	<0.001*
GCS	-0.070	0.010	-0.583	-6.737	<0.001*
PSS	0.641	0.057	0.766	11.187	<0.001*
NPMS	0.023	0.003	0.656	8.145	<0.001*
PH	-1.442	0.319	-0.434	-4.518	<0.001*
HCO3	-0.035	0.008	-0.444	-4.650	<0.001*
Na	-0.021	0.007	-0.300	-2.946	0.004*
Ca	0.256	0.071	0.360	3.620	<0.001*
ALT	0.001	0.000	0.501	5.428	<0.001*
AST	0.000	0.000	0.226	2.178	0.032*
Cr	0.321	0.045	0.605	7.125	<0.001*
WBCs	0.021	0.006	0.380	3.857	<0.001*
Platelets	-0.002	0.001	-0.266	-2.588	0.011*
a. Dependent Variable: Outcome					

Number of patients= 90, GCS: Glasgow coma scale, PSS= Poisoning Severity Score, NPMS: New Mortality Poisoning Score, PH: Power of hydrogen, HCO_3: Serum bicarbonate, Na+: Serum sodium, Ca+: serum calcium, AST: Aspartate transaminase, ALT: Alanine transaminase, Cr.: Serum creatinine, WBCs: White blood cells, RBCs: Red blood cells, P significant <0.05, Std. Error = standard error.

Table (10): Receiver operating characteristics (ROC) for prediction of mortality using GCs, new- PMS, and PSS in acutely intoxicated patients admitted to ICU in Sohag University Hospitals from January 2023 to April 2024

ROC curve between Survived and Non-Survived in Outcome						
score	**Cutoff**	**Sens.**	**Spec.**	**PPV**	**NPV**	**Accuracy**
GCS	>8	88.33	70.00	85.5	75.0	81.6%
NPMS	≤56	88.33	80.00	89.8	77.4	89.8%
PSS	≤2	88.33	96.67	98.1	80.6	92.6%

GCS: Glasgow coma scale, NMPS: New poisoning mortality score, PSS: Poisoning severity score, Sens: sensitivity, Spec: Specificity, PPV: Positive predictive value, NPV: Negative predictive value.

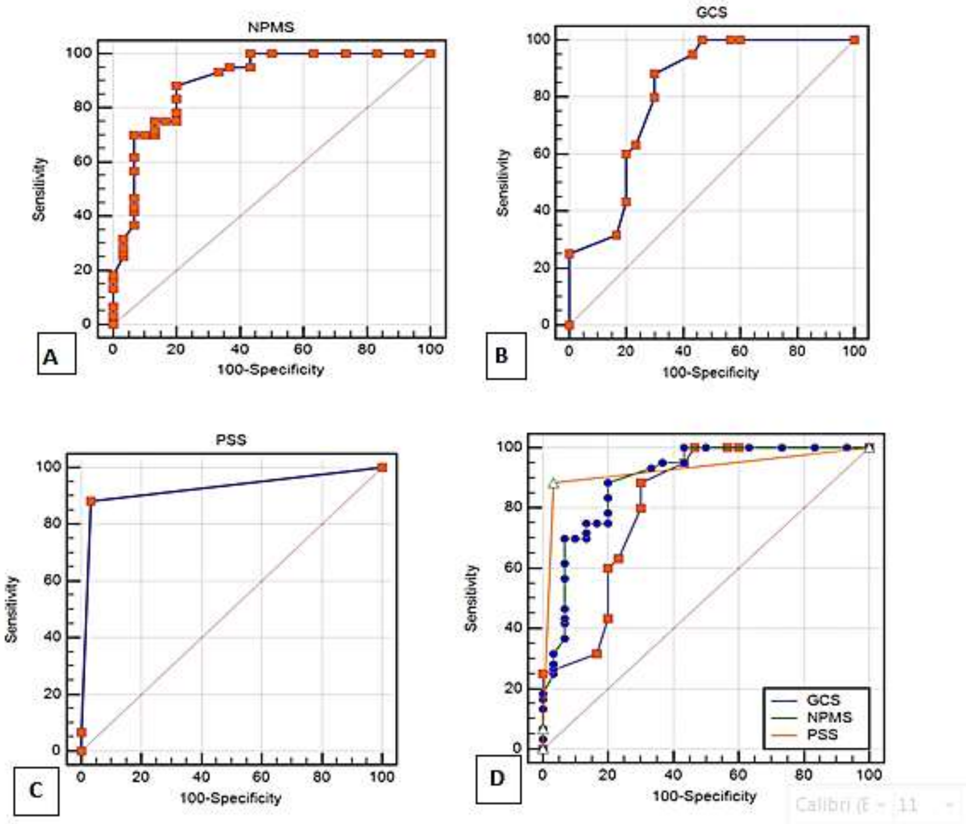

Figure (3): Receiver operating characteristics (ROC) curve for prediction of mortality in acutely intoxicated patients admitted to ICU in Sohag University Hospitals from January 2023 to April 2024 (A) New Poisoning Mortality Score (B): Glasgow Coma Score (C) Poisoning severity score (D) The three used scores

IV. DISCUSSION

The present study identified many clinical and laboratory data and three scoring systems (PSS, GCS, New-PMS) to predict mortalities in acutely poisoned patients admitted to ICU in Sohag University Hospitals. This study used the new poisoning mortality score, that was validated three years ago, and scarce studies were made on it (Han et al., 2021).

This one-year and four-month observational study provided detailed insight into the socio-demographic, clinical, and laboratory characteristics of acute intoxications admitted to a medical ICU at Sohag University hospitals.

The mortality rate among all cases was 33.33%. This goes in harmony with Saeed and Elmorsy (2024) who detected that the in-hospital mortality rate was 28% in poisoned patients admitted to the ICU. Also, Slima (2021) found that the mortality rate was slightly higher (35.5%).

The current study's noteworthy fatality rate can be ascribed to the fact that only the most evident cases of serious and potentially fatal poisoning were admitted to the intensive care unit.

The current study revealed that most cases were in the age group of 20-40 years that was like a study by Chaudhary et al. 2013 and Slima, 2021. Sulaj et al. (2015) found that the age group 15-25 had the highest incidence with 25.4% of the total cases. Ages 20 to 40 are generally associated with higher rates of stress, failures, incapacity to manage new responsibilities, and poor family interaction (Ahmed et al., 2014).

Most of the cases were females 61 % in this study as females are more vulnerable to mood disturbance. This goes in harmony with Slima (2021) who found that females were (62.5%). Also, Sulaj et al. (2015) observed that (52.5%) of the studied patients were females. In contrast, Kovacic et al. (2023) found that male cases (67.9%) were more than females. This discrepancy may be due to the difference in the studied populations.

According to the current survey, Upper Egypt's rural areas accounted for around 54.4% of the cases. This explained the nature of the population of Upper Egypt. Also, most of the cases were aluminum phosphide (28.89%) and organophosphorus (22.22%) which are agriculturally linked poisons.

Many studies gave similar results Sontakke and Kalantri, (2023); Slima, (2021); Shokry et al., (2020).

In contrast, a retrospective study by Sulaj et al., 2015 based on patient's medical records and ED registers of patients admitted at the medical ICU of “Mother Teresa” University Hospital in Tirana over two (2012-2013) years found that about 55.9% of urban residents and 44% rural ones. This difference may be due to the variability in the studied populations and the nature of the studied regions.

This study showed that suicidal attempts were higher than accidental instances (82.2% vs. 17.7%). According to Torky et al. (2023), Suicidal poisoning occurred in (70%) of the patients who presented with acute poisoning and were admitted to the ICU relatively similar to the results of the present study.

This coincides with Slima (2021) who discovered that suicidal poisoning accounted for 65.1% of all analyzed instances due to ease of access and the belief that poisoning would cause less suffering.

According to El Masry and Tawfik (2013), poisoning might be suicide (49%), unintentional (42.7%), drug-related (7.5%), homicidal (0.4%), or therapeutic error (0.4%).

Analyzing poisoned cases treated in the critical care unit, Sulaj et al. (2015) found that 87% of cases included purposeful poisoning; homicidal poisoning was not included in any of the cases.

Furthermore, in their investigation, Boshehri et al. (2012) discovered that the majority of deaths were purposeful poisonings.

In Turkey, according to Coşkun et al. (2013), the mortality rate from accidental intoxication was considerably greater than that from suicidal poisoning. They suggested that vomiting after ingesting, early hospital referral, and a small quantity of poisoning to attract attention alone could be responsible for the lower fatality rate in their suicidal cases.

As with many medical emergencies, acute poisoning can be fatal, but it can be saved with prompt diagnosis, prompt decontamination, and effective treatment.

The current study revealed that there was a statistically significant decrease in the mean values of the delay time (2-8 hours) in survivors as compared to the non-survivors (P= <0.001), and there was a significant increase in the mean length of hospital stay of survivors compared with the non-survivors (2.900 ± 1.217, 2.042 ± 1.504 days) (p=0.005).

A similar study by Slima (2021) demonstrated that about 61% of non-survivors had been poisoned for at least 6 hours. Also, Coşkun et al. (2013) were similar to the findings.

According to Sulaj et al. (2015), 44% of patients presented at the hospital within the 2- to 6-hour timeframe that separated the onset of hazardous exposure from the start of therapy. Coşkun et al. (2013) revealed that the mean length of stay in ICU was 4.2±3.6 days.

Ashwini et al. (2016) and Slima (2021) found the opposite the non-survivors had longer ICU stays due to increased toxic load, required mechanical ventilation, and experienced secondary problems.

This is because most of the cases who died immediately after being admitted to the intensive care in this study had high severity, fatal poisons (such as aluminum phosphide), and their late arrival.

Approximately 94.4% of this study cases ingested the poison, followed by inhalational poisoning at 4.4% and cutaneous exposure at 1.1%.

The study by Shokry et al. (2020) found that the majority of poisonings occurred by oral routes (81%), inhalation (3%), and dermal (0%). El Masry and Tawfik's (2013) investigation at Ain Shams Poison Control Centre found that the oral route was used in 94.9% of cases, which somewhat agrees with our findings. The poisoning route was noted as ingestion, inhalation, or numerous ways as stated by Coşkun et al. (2013).

The present study showed about 35.5% of cases needed mechanical ventilation with a significant increase in non-survivors which pointed to an ominous sign in acutely poisoned patients. There was no meaningful statistical disparity among survivors and non-survivors (p=0.613), and hemodialysis was rarely required in 2.22% of patients. These findings align with several research, including Kovacic et al., (2023); Torky et al., (2023); Slima., (2021); Karaca et al., (2020); Ashwini et al., (2016); Mathai and Bhanu (2010); Exiara et al., (2009).

The mechanically ventilated patients were due to respiratory failure or severity of symptoms at admission. The need for mechanical ventilation was significantly increased in the cases poisoned with organophosphorus (40.63%) and CO (6.25%) (P=0.002, 0.054, respectively).

Twenty-one toxic agents were tested for the outcome (survival and non-survival). No deaths were reported from benzodiazepine, theophylline, corrosive, chlorine, beta-blocker, oral hypoglycemic, calcium channel blockers, carbamate, antidepressant, lithium, and methamphetamine.

Only one death out of eight cases was reported from antipsychotic drug poisoning. Organophosphorus cases reported 13 deaths out of 20 cases.

Aluminum phosphide (29% of total deaths) and about 50% of ALP cases died) and Carbon monoxide (CO) recorded the highest significant deaths of all the observed cases as the two cases of CO poisoning involved in the study have died.

The study by According to Slima's (2021) research, venomous snakes, OP, and phosphates were the primary causes of poisoning. The greatest number of deaths (63%), followed by OP insecticides (16.7%), were caused by phosphates.

Four patients died from drug overdoses, including three from digitalis and one from sedative-hypnotics. The association between poisoning agents and patient outcomes was shown to be significantly different for phosphides ($P < 0.001$).

Shokry et al. (2020) evaluated various toxic agents in terms of results and discovered that aluminum phosphide was the most harmful toxin observed to cause mortality of about (67%), followed by calcium channel blockers (CCBs) (25%), beta-adrenergic blockers (BBs) (17%), and scorpion (15%).

The results of this study suggested that, in terms of both systole and diastole, arterial blood pressure was the sole important vital sign. Cases showed mean systolic blood pressure of 90 ± 18 mmHg, and those who showed diastolic blood pressure of 57 ± 16.5 mmHg were non-survivors. However, Coşkun et al. (2013) revealed that all vital data were insignificant to the patient outcomes.

The current work revealed that low oxygen saturation of mean value (75 ±16) was a bad sign of a non-survival outcome.

Kovacic et al. (2023) were consistent with these results as they reported that lower levels of oxygen saturation (79 ± 14) were required for mechanical ventilation which is a bad sign. The present study revealed that Low PH (acidotic) and low bicarbonate levels (7.199 ± 0.197, 16.579 ± 7.330 respectively) were significant signs of bad outcomes.

According to Abd Elghany et al. (2018), aluminum phosphide poisoning is more likely to result in acidosis and death. Oreby et al., (2016) found that if the mean value PH of 7.138 ±0.149 the patient died. Slima (2021) reported that HCO_3 mean levels of 17.38 ± 1.21mEq/L and PH at 7.19 ± 0.16 were found in non-survivors which agrees with the current study, so low PH and HCO_3 levels are considered bad signs for the acutely poisoned patients.

The high mean levels of serum creatinine (1.912 ± 1.181) were observed in non-survivors, this can be explained by primary renal injury as occurring with organophosphorus compounds or secondary due to renal hypoperfusion because of shock as happens with aluminum phosphide (Banday et al., 2015; Farzaneh et al., 2018). This was also recorded by (Oreby et al., 2016 and Kovacic et al., 2023).

White blood cells (WBCs) were found high in non-survivors with mean values of 18.861 ± 12.985. This may be due to ICU-acquired infection. This was also found by (Oreby et al., 2016).

Serum levels of ALT and AST were elevated in both survivors (IQR = 20 (14-27.5; 21.5 (17-30)) and non-survivors (IQR= 200 (61-26; 30 (19-82)), with non-survivors showing greater levels of AST. Likewise (Slima, 2021).

Injury to hepatocytes alters membrane permeability and causes excessive transaminase leakage. According to Kasarala and Tillmann (2016), Periportal cells have elevated ALT levels, whereas cells in the vicinity of the central vein are more vulnerable to toxic insults, leading to raised AST levels.

In the present study, three easily applicable scoring systems were used to predict mortality (GCS, PSS, New-PMS). The New- PMS was calculated by adding the scores from each of the 10 prediction categories. The possible range of the NEW- PMS was 0-137 points.

Logistic regression analysis recorded that the use of PSS was the most predicting factor for mortality in the studied groups (P<0.001), followed by increased delay time (P<0.001), NMPS (P<0.001), GCS (P<0.001), mechanically ventilated patients (P<0.001), and acidotic PH (P=0.001).

Receiver operating characteristics (ROC) curve for prediction of mortality illustrated that the lesser accurate was GCS with an AUC was 0.816%, at a point of < 8, specificity 70%, sensitivity was 88.33 %, NPV 75%, PPV was 85.5%, and accuracy 81.6%, then NEW- PMS (AUC was 0.898, at a point of ≥ 56, specificity 80%, sensitivity is 88.33 %, NPV 77.4%, PPV 98.1%, accuracy 89.8%). The PSS showed the highest accuracy in predicting mortality with AUC of 0.926, ≥ 2, specificity 96.67%, sensitivity 88.33 %, NPV 80.6%, PPV 98.1 %, and accuracy 92.6%.

Results with the area under the curve for the New-PMS were almost identical according to Han et al. (2021), who validated the New-PMS was 0.941 (95% Confidence interval of 0.934-0.949, p<0.001) and 0.946 (95% confidence interval of 0.929-0.964, p<0.001) in the derivation and validation groups, respectively. The New-PMS (cutoff value: 49 points) has a sensitivity, specificity, and accuracy of 86.4%, 87.2%, 87.2%, 85.9%, 89.5%, and 89.4% in the derivation and validation groups, respectively.

Saeed and Elmorsy (2024), evaluated the effectivity of new PMS in comparison with PSS to predict mortality in cases with acute poisoning admitted to ICU. The best cut-off points for predicting mortality for new PMS and PSS were > 53 and > 2, with sensitivities of 67.9% and 85.7%, and specificities of 73.6% and 84.7%, respectively that's proceeding in unison with the present study results.

In agreement with the present results, Lee et al. (2024) detected that the new PMS showed better performance in predicting mortality in patients with acute poisoning, in terms of AUC, sensitivity, specificity, and accuracy were 0.947, 0.863, 0.912, and 0.911 respectively. According to a study by Moorthy et al. (2023) in predicting in-hospital mortality in acute organophosphorus-poisoned patients using New-PMS. The best cut-off was >65, with a sensitivity of 77.27%, specificity of 96.26%, and AUC of 0.917.

The usefulness of clinical measures such as GCS, and poisoning severity scoring systems in severity assessment that in turn can be used to predict outcomes in patients with acute poisoning especially, during triage (Bhat et al.,2021).

According to a study done by Patel et al. (2021), they found that PSS and GCS are simple and effective tools in predicting the severity and outcome of poisoning in patients presenting to the emergency department. El-Sarnagawy and Hafez (2017), found that a GCS of ≤8 on entry was a 100% accurate predictor of mechanical ventilation in drug-overdosed individuals. In research by Davies et al., (2008), the following were found as regards PSS: specificity (79%), sensitivity (78%), and the area under curve (0.81) which is almost like the current study.

V. CONCLUSION & RECOMMENDATIONS

Accurate and specific prediction of mortality can save many other patients admitted to the ICU. When a patient presents with acute poisoning, the course of their treatment can be predicted via using vital signs at admission, routine laboratory work, and toxicological data. Increasing public awareness of the dangerous effects of aluminum phosphide and organophosphorus poisons is very important. Three quick and easy scoring systems that are based on toxicological and clinical data collected at the time of admission, the Glasgow Coma Scale, the New-Poisoning Mortality Score, and the Poisoning Severity Score can be used to predict death in cases of acute poisoning.

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المتنبئات السريرية والمخبرية للوفاة الناتجة عن التسمم الحاد لمرضى وحدة العناية المركزة، مع إيلاء إعتبار خاص للمقياس الجديد لمعدل وفيات التسمم

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المقدمة: تتزايد زيارات قسم الطوارئ الناتجة عن التسمم الحاد وغالبًا ما يحتاج ذلك إلى علاج في وحدة العناية المركزة.

الهدف: هدفت هذه الدراسة إلى تقييم دور الخصائص السريرية والمخبرية للمرضى الذين يعانون من التسمم الحاد الذين تم إدخالهم إلى وحدات العناية المركزة في التنبؤ بمعدل الوفيات مع إيلاء اعتبار خاص لمقياس وفيات التسمم الجديد.

المرضى وطرق البحث: أجريت هذه الدراسة المقطعية على مرضى التسمم الحاد بعمر 18 سنة فما فوق من كلا الجنسين الذين تم دخولهم إلى وحدة العناية المركزة بمستشفيات سوهاج الجامعية. تم تسجيل البيانات الديموغرافية والسمية والعلامات الحيوية ودرجة غلاسكو للغيبوبة ودرجة المقياس الجديد لمعدل وفيات التسمم و مقياس شدة التسمم والفحوصات المخبرية مثل غازات الدم الشرياني ووظائف الكبد والكلى صورة الدم وربطها بنتيجة التسمم لدى المريض.

النتائج: شملت الدراسة 90 مريضا. أظهرت النتائج أن 62.22 % من المرضى كانوا في الفئة العمرية 20-40 سنة و 61.11% كانوا من الإناث. كان معدل الانتحار 82.22%. فوسفيد الألومنيوم والفوسفور العضوي والأدوية النفسية هم أكثر العوامل السامة تعرضًا في هذه الدراسة. وكان معدل الوفيات الإجمالي 33.33٪. فيما يتعلق بالخصائص السريرية والمعملية للمرضى، أظهر ضغط الدم الانقباضي والانبساطي، وتشبع الأكسجين، والحاجة إلى التنفس الصناعى و درجة الحموضة بالدم، ومستوى كل من HCO_3, Na، Ca، ALT، AST، الكرياتينين، كرات الدم البيضاء وعدد الصفائح الدموية فرقًا كبيرًا بين الناجين وغير الناجين من المرضى. أفضل النقاط الفاصلة للتنبؤ بالوفيات للمقياس الجديد لمعدل وفيات التسمم ، ومقياس شدة التسمم، ودرجة غلاسكو للغيبوبة كانت أكثر من أو يساوى 56 و أكثر من أو يساوى 2 و أقل من 8 بحساسية 88.33٪ للجميع، وخصوصيات 80٪، 96.67٪، و70٪. ودقة 89.8% و92.6% و81.6% على التوالي.

الاستنتاج: باستخدام البيانات الديموغرافية والسمية للمريض، والتحليلات المخبرية الروتينية، والعلامات الحيوية عند دخول المستشفى يمكن التنبؤ بالنتيجة للمرضى الذين يعانون من التسمم الحاد.

التوصيات: زيادة الوعي العام بالآثار الخطيرة للتسمم بالألومنيوم فوسفيد والفوسفور العضوي أمرًا مهمًا للغاية حيث أنهم كانوا أكثر المواد السامة شيوعًا في الدراسة. يعد المقياس الجديد لمعدل وفيات التسمم أداة بسيطة وسريعة وسهلة التطبيق لاستخدامها كعلامة إنذار للتنبؤ بالوفيات في حالات التسمم الحاد.