MORTALITY PREDICTION IN ACUTE METHANOL INTOXICATION: ROLE OF POISON SEVERITY SCORE AND SEQUENTIAL ORGAN FAILURE ASSESSMENT SCORE

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ABSTRACT

Background: Acute methanol intoxication is a serious health problem that affects people all over the world causing high morbidity and mortality. **Aim of the study:** was to determine predictors of mortality and evaluate the role of Poison Severity Score (PSS) and Sequential Organ Failure Assessment score (SOFA) as early outcome indicators among patients with acute methanol intoxication. **Subjects and Methods:** A retrospective and prospective study included 64 patients with acute methanol intoxication presented to The Poison Control Center of Ain Shams University Hospitals from January 2021 to December 2022. Data such as demographics, exposure history, clinical findings, and results of laboratory investigations were gathered and the patients were scored on PSS and SOFA score. **Results**: Out of the 64 included patients, 22 patients were non- survivors. The mean systolic and diastolic blood pressure as well as temperature, GCS, pH and Hco3 were significantly lower among non-survivors with significantly higher respiratory rate, base deficit, RBS, BUN, serum creatinine, platelet count, INR, P.T., PTT, PSS and SOFA score than survivors. **Conclusion**: Systolic blood pressure ≤90 mmHg, diastolic blood pressure ≤60 mmHg, temperature ≤36.5, respiratory rate >28 cycle/min, occurrence of seizures and shock, GCS ≤9, presence of coma on admission, PH ≤7.01, HCO3 ≤7.7 mmol/L, base deficit >20.7 mmol/L, BUN >30 mg/dl, serum creatinine>1.6 mg/dl, RBS >180 mg/dl, platelet count >345, INR >1.25, prothrombin time >15 seconds, partial thromboplastin time >35 seconds, need for mechanical ventilation, severe PSS and SOFA >5 are significant mortality predictors. However, the SOFA score is the early accepting and most accurate mortality predictor.

Keywords: *Methanol, Mortality, Predictors, PSS, SOFA*

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INTRODUCTION

Methanol, commonly known as methyl alcohol or wood alcohol, is a flammable, clear, colorless liquid with a sugary, sweet odor. It is created through the distillation of wood or chemical synthesis from natural gas or coal. Methanol is utilized in a variety of industrial processes such as the manufacture of formaldehyde, methyl tert-butyl ether and acetic acid, as well as the production of biodiesel and in the paint and plastics industries as a solvent. Because it burns cleaner than gasoline, it is also utilized as a fuel in race vehicles, airplanes and boats. Methanol is a widely used alternative fuel because it is abundant, renewable and can be generated from many sources ***(Allata et al., 2023)***.

Acute methanol intoxication can occur accidently or due to adulterated wine or as a result of suicide attempts. In many developing countries, methanol is utilized in the manufacture of unlawful drinks that include alcohol due to its availability and inexpensive cost ***(Giovanetti, 2013; Alqurashi et al., 2023)***.

Methyl alcohol toxicity is a serious issue because of its long term morbidities and high fatality rate. Apart from the permanent impairments methanol poisoning livings suffered, records show that up to 44% of those affected die ***(Kurtas et al., 2017; Md Noor et al., 2020)***.

There was a marked rise in methanol induced mortality following the start of the COVID-19 pandemic due misinformation regarding the alcohol's ability to neutralize the virus ***(Mousavi-Roknabadi et al., 2022)***.

Due to delayed patient arrival and diagnosis, the high cost of fomepizole as well as lack of measurement of methanol level in a lot of medical facilities, methyl alcohol intoxication in Egypt continues to show unfavorable outcomes ***(Rezk and Allam, 2009)***.

The methanol-induced multi-organ system failure is mostly mediated by formic acid, the principal methanol toxic metabolite. It disrupts the enzyme cytochrome oxidase resulting in dysfunction of the mitochondria ***(Kaewput et al. 2021)***.

Formic acid causes irreversible vision loss by destroying optic nerve. In addition, methanol poisoning causes severe neurological, metabolic and renal impairments. Also, respiratory failure and cardiac arrhythmia are frequent occurrences ***(Paasma et al., 2012)***.

Decontamination and supporting measures are the first steps in the treatment of patients with methanol intoxication, in addition to corrective metabolic therapy. Fomepizole or ethanol antidotal therapy is essential because it inhibits toxic metabolite formation. Hemodialysis is a crucial therapy to increase the removal of harmful metabolites ***(Rietjens et al., 2014)***.

Many scoring systems have been established over time to measure the severity of illnesses, their progression and prognosis as well as to evaluate medications and estimate the cost impact of intensive care ***(Barghash et al., 2017)***.

Poison Severity Score, a scoring system that evaluates the poisoning severity based on clinical symptoms and has been utilized to grade a variety of different types of poisoning. Additionally, the Sequential Organ Failure Assessment score exhibits a significant association with fatality and a strong ability to discriminate fatality prediction ***(Kim et al., 2013; Wang et al., 2019)***.

THE AIM OF THE WORK

The current study aimed to determine the effective in-hospital predictors of mortality in acutely methanol intoxicated patients and evaluate the role of Poison Severity Score (PSS) and Sequential Organ Failure Assessment score (SOFA) as early outcome indicators.

SUBJECTS AND METHODS

Study design and setting:

This work was planned as a cross-sectional retrospective and prospective study involved acutely methanol intoxicated patients presented to Poison Control Center, Ain Shams University Hospitals (PCC-ASUH) in the period of January 2021 until December 2022.

Methanol poisoning is diagnosed primarily by a positive history of methanol administration (by the patient or by family members), occurrence of specific symptoms and signs, such as high anion gap metabolic acidosis, neurological manifestations and visual impairment which range from blurred vision to vision loss ***(Hovda et al., 2005; Zakharov et al., 2016)***.

Inclusion and exclusion criteria:

All individuals, male and female, with acute methanol poisoning were enrolled in this study during that time. Those suffering from metabolic acidosis caused by diabetes mellitus, chronic kidney disease and starvation were not included, as were those of insufficient medical records, co-ingestions, or chronic visual impairments.

Based on the outcome, the included patients were classified into survivors group (with or without complications) and non- survivors group.

Ethical Considerations:

Data were collected after approval of the Research Ethics Committee of Faculty of Medicine Ain Shams University **(approval number: FMASU R 96/2022)**. Also, an approval had been obtained from the general director of the PCC -ASUH. The patients or their relatives gave informed consent. All data was saved anonymously in order to maintain confidentiality. The information gathered was exclusively utilized for the purposes of the study.

Sample Size:

The study included 64 patients with acute methanol poisoning. Power Analysis and Sample Size software version 11(PASS 11), setting power at 99% and alpha error at 5% was used to determine the sample size. After reviewing previous study results ***(Mansour et al., 2018)***, a sample size of at least 50 patients

diagnosed with acute methanol poisoning is needed to achieve the study objective.

Data collection:

In each group, demographics and history including age, sex, poisoning manner, exposure route, delay time and presenting complaints were recorded.

Clinical data and scoring including: Vital data and Glasgow coma scale (GCS) to assess consciousness level were recorded upon admission. Respiratory, neurological, gastrointestinal and ophthalmologic manifestations were documented.

The laboratory investigations included blood gas analysis and blood electrolytes such as sodium (Na), potassium (K), calcium (Ca) and chloride (Cl). Moreover, random blood sugar (RBS), full blood count, liver transaminases, blood urea nitrogen (BUN) and serum creatinine were recorded. International normalization ratio (INR), prothrombin time (P.T.) and partial thromboplastin time (PTT) also were documented.

PSS was utilized to assess poisoning severity when the most intense manifestations occur ***(Persson et al., 1998)***. PSS grading was defined as follows: (0): None, no manifestations, (1): Mild, transient manifestations, (2): Moderate, Pronounced manifestations, (3): Severe or life threatening manifestations and (4): Death.

SOFA score was used, which ranged from 0–24. It was based on six separate scores, one for each of the respiratory, neurological, cardiovascular, hepatic, coagulation, renal systems with each scored from 0 to 4. An increasing score reflecting worsening organ dysfunction ***(Ferreira and Sakr 2011; Lambden et al., 2019)***. SOFA score was calculated when each sample is being collected. All patients were treated according to treatment protocols of PCC-ASUH.

Statistical Analysis

The Statistical Package for Social Science software (SPSS) version 22 was used to statistically analyze the data that had been gathered. Mean, standard deviation (±SD), minimum and maximum values (range) were obtained for numerical data. Frequency and percentage were obtained for non-numerical data. The comparison between two groups with qualitative data was done by Pearson's Chi-Square test. The comparison between two groups with quantitative data was done by Independent t-test while Mann-Whitney U-test was utilized to compare continuous data.

Univariate binary logistic regression was used to determine the effect of various variables as predictors of outcome. In multivariate analysis, significant predictors were included. The receiver operating characteristic (ROC) curve was used to define the predictors best cutoff, specificity and sensitivity. The area under the curve (AUC) was defined as follows: excellent (0.9–1), good (0.8–0.9), fair (0.7–0.8), poor (0.6–0.7) and fail (0.5–0.6) ***(Jessen and Menard 1996)***. A significance level of $P < 0.05$ was considered for all performed tests.

RESULTS

The current study enrolled 64 patients with acute methanol intoxication who were categorized into survivors group (42 patients representing 65.6%) and non-survivors group (22 patients representing 34.4%). As regard survivors group, complete recovery was observed in 42.2% while 10.9% had decreased visual acuity and 12.5% became blind (**Figure 1)**.

The median age was 36 years of studied patients with male predominance. The patients under the study presented to PCC-ASUH with median delay time 24 hours. The majority of exposures (92.2%) happened as a result of ingestion of adultered ethanol while unintentional ingestion in non-labeled containers was the least exposures. No significant difference was found between survivors and non-survivors as regards age, sex, alcohol consumption habit, delay time, manner of poisoning and route of exposure as illustrated in **table (1)**.

There were highly significant statistical differences between survivors and non-survivors as regards systolic and diastolic blood pressure, temperature, respiratory rate and occurrence of shock. While, no significant difference was detected regarding pulse between both groups. There was 59.4% of patients presented with coma with mean ±SD of GCS was 10.75± 4.92. There was highly significant difference between survivors and non-survivors as regards

presence of coma, GCS and occurrence of seizures. Regarding visual manifestations, there was significant difference between survivors and non-survivors. No significant difference was found as regards chest auscultation or presence of vomiting as shown in **table (2)**.

Tables (3, 4) show laboratory parameters among studied groups. It was observed that 92.2% of studied patients suffered from metabolic acidosis. Significantly lower values of pH and Hco3 was found in non-survivors group in comparison to survivors group. While, significantly higher base deficit, BUN, serum creatinine and random blood sugar was observed among non-survivors as opposed to survivors. There was no significant difference between both groups as regards serum electrolytes, anion gap or liver enzymes.

As regards full blood count, only platelet count was significantly elevated in non-survivors as opposed to survivors. Significant prolonged PT, PTT and INR was found among non-survivors compared to those of survivors.

Table (5) reveals that no significant difference was observed between survivors and non-survivors as regards hospital stay duration. Mechanical ventilation was needed in 29.7% of total patients and highly significant difference was found between both studied groups as regards need for mechanical ventilation. Majority of total patients (59.4%) had initial severe PSS with high significant difference was found between both groups as regards PSS. Also, non-survivors scored significantly higher SOFA score than survivors.

Table (6) shows the univariate and multivariate logistic regression analysis for factors associated with mortality due to acute methanol intoxication. The initial univariate analysis was performed to determine the different parameters effect as mortality predictors. Among the examined variables, systolic blood pressure ≤90 mmHg, diastolic blood pressure ≤60 mmHg, temperature ≤36.5, respiratory rate >28 cycle/min, occurrence of seizures and shock, GCS≤9, presence of coma on admission, PH ≤7.01, HCO3 ≤7.7 mmol/L, base deficit >20.7 mmol/L, blood urea nitrogen >30 mg/dl, serum creatinine>1.6 mg/dl, random blood sugar >180 mg/dl, platelet count >345 INR>1.25, prothrombin time, >15 seconds, partial thromboplastin time >35 seconds, need for mechanical ventilation, severe PSS and SOFA >5 scores were significant predictors. In multivariate analysis, only the SOFA score demonstrated meaningful predictive ability.

Figure (2) shows the Receiver Operating Characteristic (ROC) curve, analyzing sensitivity and specificity of SOFA score in predicting the occurrence of mortality in the studied patients. It was found that SOFA score more than 5 could significantly predict mortality in methanol intoxicated patients with 95.5% sensitivity, 97.6% specificity and an excellent AUC (0.989).

Table (1): Sociodemographic and intoxication characteristics of survivors and non-survivors with acute methanol intoxication.

Characteristics		Survivors	Non-survivors	Total	Test value	P-value
		No. = 42	No. = 22	No. = 64		
Age (Years)	Median (IQR)	30 (25 – 43)	40.5 (33 – 44)	36 (27 – 43.5)	MW= -1.769	0.077
	Range	1 – 85	21 – 53	1 – 85		
Sex	Female	1 (2.4%)	2 (9.1%)	3 (4.7%)	$\chi 2$= 1.455	0.228
	Male	41 (97.6%)	20 (90.9%)	61 (95.3%)		
Alcohol consumption habit	No	32 (76.2%)	14 (63.6%)	46 (71.9%)	$\chi 2$= 1.126	0.289
	Alcoholic	10 (23.8%)	8 (36.4%)	18 (28.1%)		
Delay time (hours)	Median (IQR)	24 (14 – 36)	24 (12 – 36)	24 (13.5 – 36)	MW= -0.287	0.774
	Range	1 – 96	3 – 48	1 – 96		
Manner of poisoning	Homemade alcohol	37 (88.1%)	22 (100.0%)	59 (92.2%)	$\chi 2$= 2.841	0.092
	Unintentional ingestion	5 (11.9%)	0 (0.0%)	5 (7.8%)		
Route of exposure	Oral	42 (100.0%)	22 (100.0%)	64 (100.0%)		

P-value >0.05: Non significant, P-value <0.05: Significant (*) and P-value< 0.01: highly significant (**). No: Number IQR: interquartile range. $\chi 2$= Pearson's Chi- Square test. MW =Mann-Whitney U test.

Table (2): Presenting complaints and clinical findings of survivors and non-survivors with acute methanol intoxication.

Variable		Survivors	Non-survivors	Total	Test value	P-value
		No. = 42	No. = 22	No. = 64		
Pulse	Mean ± SD	95.07 ± 21.85	93.18 ± 23.95	94.42 ± 22.42	t =0.318	0.752
Systolic blood pressure	Mean ± SD	122.62 ± 22.53	94.55 ± 30.66	112.97 ± 28.71	t =4.171	0.000**
Diastolic blood pressure	Mean ± SD	75.95 ± 13.63	59.09 ± 17.70	70.16 ± 17.04	t =4.234	0.000**
Temperature	Mean ± SD	37.07 ± 0.20	36.89 ± 0.31	37.01 ± 0.26	t =2.921	0.005**
Respiratory rate	Mean ± SD	27.64 ± 7.20	33.59 ± 11.25	29.69 ± 9.17	t =-2.573	0.000**
Shock	Absence	41 (97.6%)	11 (50.0%)	52 (81.3%)	χ2=21.490	0.000**
	Presence	1 (2.4%)	11 (50.0%)	12 (18.8%)		
Coma	Absence	23 (54.8%)	3 (13.6%)	26 (40.6%)	χ2=10.123	0.001**
	Presence	19 (45.2%)	19 (86.4%)	38 (59.4%)		
GCS	Mean ± SD	13.57 ± 1.99	5.36 ± 4.30	10.75 ± 4.92	t =10.458	0.000**
Seizures	Absence	40 (95.2%)	15 (68.2%)	55 (85.9%)	χ2=8.745	0.003**
	Presence	2 (4.8%)	7 (31.8%)	9 (14.1%)		
Vomiting	Absence	18 (42.9%)	13 (59.1%)	31 (48.4%)	χ2=1.523	0.217
	Presence	24 (57.1%)	9 (40.9%)	33 (51.6%)		
Chest auscultation	Normal	40 (95.2%)	22 (100.0%)	62 (96.9%)	χ2=1.081	0.298
	Wheezes	2 (4.8%)	0 (0.0%)	2 (3.1%)		
Visual manifestations	Absence	17 (40.5%)	15 (68.2%)	32 (50.0%)	χ2=4.433	0.035*
	Presence	25 (59.5%)	7 (31.8%)	32 (50.0%)		

P-value >0.05: Non significant, P-value <0.05: Significant (*) and P-value< 0.01: highly significant (**) No: Number. SD: standard deviation. χ2= Pearson's Chi- Square test. t= Independent t-test

Table (3): Analysis of blood gases in survivors and non-survivors with acute methanol intoxication.

		Survivors	Non-survivors	Total	Test value	P-value
		No. = 42	No. = 22	No. = 64		
pH	Mean ± SD	7.16 ± 0.18	6.89 ± 0.10	7.07 ± 0.20	t= 6.588	0.000**
PCO_2 (mmHg)	Mean ± SD	24.57 ± 11.39	30.64 ± 14.04	26.65 ± 12.59	MW = -1.869	0.066
HCO_3(mmol/L)	Mean ± SD	6.85 (5 – 10.9)	3.95 (3 – 6.7)	5.75 (3.55 – 9.55)	MW = -3.302	0.001**
Base deficit (mmol/L)	Mean ± SD	17.88 ± 7.84	24.48 ± 2.74	20.15 ± 7.25	t= -3.816	0.000**
PO2	Median (IQR)	58 (42 – 120)	74 (44 – 157)	61.5 (43.5 – 122)	MW = -1.259	0.208
Anion gap	Mean ± SD	34.21 ± 11.79	40.12 ± 10.64	36.24 ± 11.67	t= -1.968	0.054
Metabolic acidosis	No	5 (11.9%)	0 (0.0%)	5 (7.8%)	χ2= 2.841	0.092
	Yes	37 (88.1%)	22 (100.0%)	59 (92.2%)		

P-value >0.05: Non-significant, P-value <0.05: Significant (*) and P-value< 0.01: highly significant (**). No: Number. SD: standard deviation. IQR: interquartile range. χ2= Pearson's Chi- Square test. t= Independent t-test MW =Mann-Whitney U test.

Table (4): Laboratory parameters of survivors and non-survivors with acute methanol intoxication.

Variable		Survivors	Non-survivors	Total	Test value	P-value
		No. = 42	No. = 22	No. = 64		
Sodium (mEq/L)	Mean ± SD	139.52 ± 10.45	140.14 ± 7.33	139.73 ± 9.44	t=-0.245	0.807
Potassium (mEq/L)	Mean ± SD	4.35 ± 1.11	4.70 ± 1.14	4.47 ± 1.12	t=-1.159	0.251
Calcium (mmol/l)	Median (IQR)	0.83 (0.68 – 1)	0.8 (0.66 – 5.3)	0.82 (0.68 – 1.08)	MW =-0.500	0.617
Chloride (mEq/L)	Mean ± SD	100.18 ± 4.44	99.89 ± 5.77	100.08 ± 4.89	t=0.225	0.823
BUN(mg/dl)	Median (IQR)	20 (14 – 24)	26 (14 – 40)	22 (14 – 29)	MW =-2.229	0.026 *
Creatinine (mg/dl)	Median (IQR)	1.1 (0.8 – 1.4)	1.8 (1.3 – 2.1)	1.3 (0.9 – 1.8)	MW =-3.564	0.000 **
AST (IU/L)	Median (IQR)	24 (20 – 32)	25.5 (22 – 82)	25 (21 – 34)	MW =-1.450	0.147
ALT (IU/L)	Median (IQR)	18 (14 – 23)	20 (15 – 61)	18.5 (15 – 25.5)	MW =-1.565	0.118
RBS (mg/dl)	Mean ± SD	139.17 ± 57.26	205.68 ± 99.49	162.03 ± 80.29	t=-3.401	0.001 **
RBC (*10^3/mm^3)	Mean ± SD	5.65 ± 0.74	5.24 ± 0.82	5.53 ± 0.78	t=1.790	0.079
WBC (*10^3/mm^3)	Mean ± SD	13.69 ± 5.50	16.89 ± 6.18	14.70 ± 5.86	t=-1.908	0.062
PLT (*10^3/mm^3)	Mean ± SD	287.57 ± 84.55	350.18 ± 90.37	307.28 ± 90.46	t=-2.474	0.017 *
Hemoglobin (gm/dl)	Mean ± SD	15.91 ± 2.08	15.04 ± 2.52	15.64 ± 2.23	t=1.340	0.186
INR	Mean ± SD	1.19 ± 0.21	1.46 ± 0.49	1.29 ± 0.35	t=-2.648	0.011 *
P.T.	Median(IQR)	14 (12.6 – 14.95)	15.6 (14.2 – 17.65)	14.4 (12.9 – 15.95)	MW =-2.865	0.004 **
PTT	Median (IQR)	28.2 (24.7 – 31.6)	42.3 (29 – 76.7)	29.15(27.15– 38.25)	MW =-3.926	0.000 **

RBC: red blood cell count, WBC: white blood cell count, PLT: platelet count, RBS: random blood sugar, BUN: blood urea nitrogen, P.T.: Prothrombin time, PTT: partial thromboplastin time, AST: aspartate transaminase, ALT: alanine transaminase, and INR: international normalization ratio χ2= Pearson's Chi- Square test. t= Independent t-test MW =Mann-Whitney U test. No: Number IQR: interquartile range SD:standard deviation P-value >0.05: Non significant, P-value <0.05: Significant (*) and P-value< 0.01: highly significant (**).

Table (5): Hospital stay duration, Need for mechanical ventilation, hemodialysis performed, PSS and SOFA score of survivors and non-survivors with acute methanol intoxication.

Variable		Survivors	Non-survivors	Total	Test value	P-value
		No. = 42	No. = 22	No. = 64		
Hospital stay duration (Days)	Median (IQR)	2 (1 – 3)	2 (1 – 6)	2 (1 – 3)	MW =-0.441	0.659
Need for mechanical ventilation	No	39 (92.9%)	6 (27.3%)	45 (70.3%)	χ2= 29.750	0.000**
	Yes	3 (7.1%)	16 (72.7%)	19 (29.7%)		
Hemodialysis performed	No	26 (61.9%)	13 (59.1%)	39 (60.9%)	χ2= 0.048	0.827
	Yes	16 (38.1%)	9 (40.9%)	25 (39.1%)		
PSS	Minor	12 (28.6%)	0 (0.0%)	12 (18.8%)	χ2= 18.238	0.000**
	Moderate	13 (31.0%)	1 (4.5%)	14 (21.9%)		
	Severe	17 (40.5%)	21 (95.5%)	38 (59.4%)		
SOFA score	Median (IQR)	1 (1 – 2)	11 (9 – 12)	2 (1 – 9)	MW =-6.457	0.000**

χ2= Pearson's Chi- Square test MW =Mann-Whitney U test. No: Number IQR: interquartile range, P-value >0.05: Non significant, P-value <0.05: Significant (*) and P-value< 0.01: highly significant (**).

Table (6): Univariate and multivariate logistic regression analysis for factors associated with mortality for the studied patients.

Univariate logistic regression				
Variable	P-value	Odds ratio (OR)	95% C.I. for OR	
			Lower	Lower
Systolic blood pressure ≤90	0.000**	12.950	3.617	46.363
Diastolic blood pressure ≤60	0.001**	7.515	2.348	24.054
Temperature ≤36.5	0.028*	12.059	1.309	111.055
Respiratory rate >28	0.002**	6.039	1.950	18.704
Seizures	0.009**	9.333	1.740	50.067
Shock	0.001**	41.000	4.764	352.888
GCS ≤9	0.000**	82.333	15.167	446.937
Coma on admission	0.003**	7.667	1.966	29.896
PH ≤7.01	0.000**	105.000	12.061	914.124
HCO3 ≤7.7	0.008**	17.348	2.133	141.112
Base deficit >20.7	0.002**	25.421	3.125	206.782
Bun >30	0.002**	7.917	2.096	29.898
Creatinine>1.6	0.000**	8.750	2.665	28.726
RBS>180	0.001**	7.200	2.159	24.017
Platelet count >345	0.002**	6.039	1.950	18.704
INR>1.25	0.040*	3.228	1.056	9.872
P.T. >15	0.006**	4.780	1.575	14.510
PTT >35	0.000**	8.500	2.558	28.250
Need for mechanical ventilation	0.000**	34.667	7.711	155.848
PSS severe	0.001**	30.882	3.787	251.831
SOFA>5	0.000**	81.000	51.256	146.156
Multivariate logistic regression				
SOFA>5	0.000**	81.000	51.256	146.156

P-value >0.05: Non significant; P-value <0.05: Significant (*); P-value< 0.01: highly significant (**).

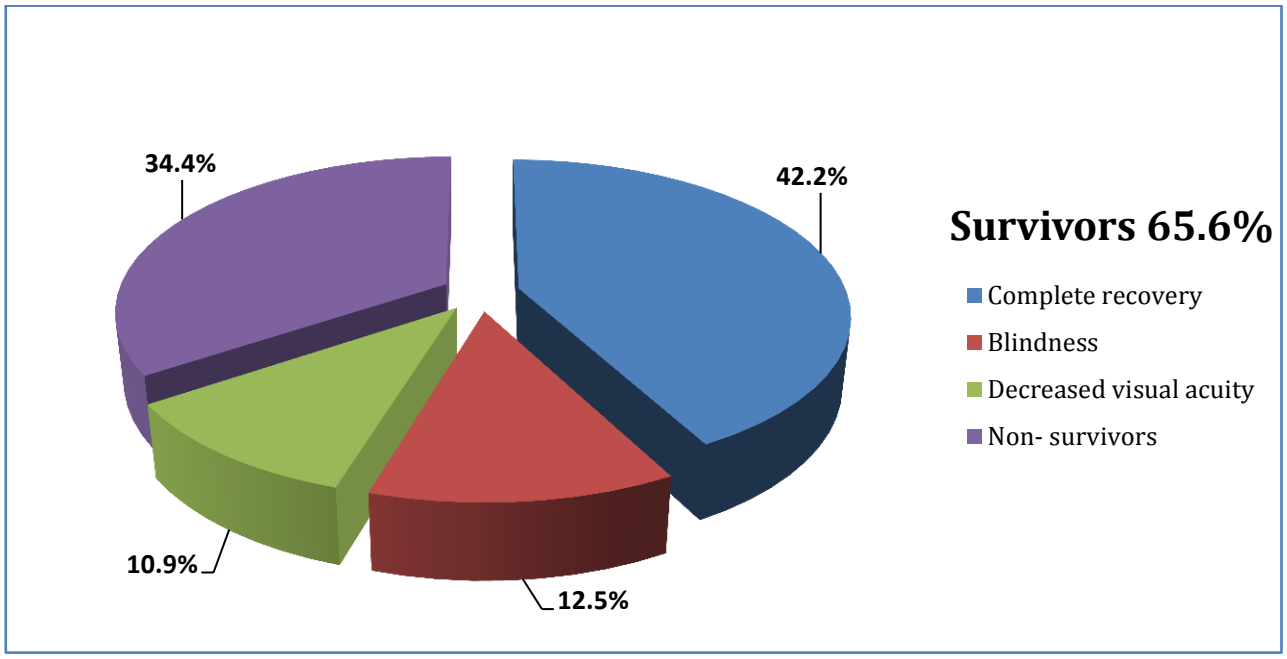

Figure (1): Pie chart shows outcome of the studied patients.

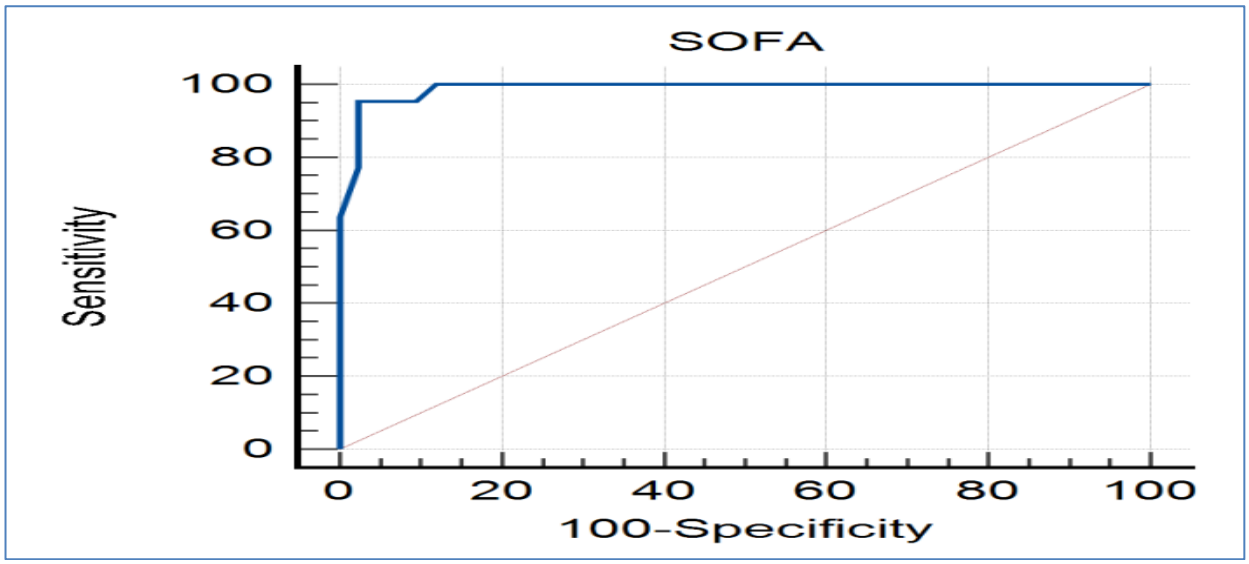

Figure (2): Receiver operating characteristic curve (ROC) for SOFA score. At a cutoff of greater than 5, the SOFA score could significantly predict mortality in acute methanol intoxication with 97.6% specificity, 95.5% sensitivity and an excellent AUC of 0.989.

DISCUSSION

Despite having adequate management and antidotes, methanol poisoning causes significant burdens to the health system due to its elevated incidence of morbidities and mortalities ***(Abdelwahab et al., 2022)***.

In the current study, 22 patients died out of a total of 64 representing 34.4%. This result goes in accordance with ***Hassanian-Moghaddam et al. (2007)*** and ***Lee et al. (2014)***. They reported mortality rate of 34.4% and 48% respectively.

On contrary, ***Nizhu et al. (2018)*** and ***Yousefinejad et al. (2020)*** stated that, fatality rate of 18% and 15.4% respectively.

This variability of outcome could be as a result of the difference in the features of patients, severity of poisoning and the established protocols of treatment ***(Elbastawesy et al., 2022)***.

In this study, adult males with a median age of 36 years predominated. These results were in agreement with ***Sharif et al. (2021)*** who reported the median age of studied patients was 29 years and males made up the majority of the poisoned patients (83.8%).

Also, ***Elbastawesy et al. (2022)*** reported young males predominate with a 24 year old median age.

On the other hand, ***Chang et al. (2019)*** stated that, a mean age of 47.8 ± 14.9 years and ***Rulisek et al. (2020)*** reported a rise in the number of cases of methyl alcohol poisoning in older people aged 50.9 ± 2.6 years. The observed age variation indicates that methanol intoxication occurs in every age range.

Males are more likely to use counterfeit alcohol, making them more vulnerable to methyl alcohol poisoning and mortality ***(Kurtas et al., 2017)***.

This study found that accidental exposure predominated with no intention to commit suicide. This was close to ***Sharif et al. (2021)*** who found that all patients were accidentally exposed and partially agreeing with ***Chang et al. (2019)*** who stated that suicidal exposure was not rare elsewhere, despite unintentional exposure being the most common type of exposure.

In the current study, no significant difference was found between survivors and non-survivors as regards delay time with median delay time 24 hours.

This was in accordance with ***Masoud et al. (2016)*** who found non-significant difference in delay time between survivors and non-survivors and ***Sharif et al. (2021)*** who reported a potential delay in hospital presentation of median 24 hours.

Unlikely, significantly extended delay time in patients with poor outcomes was observed by the ***Yousefinejad et al. (2020)*** and ***Elbastawesy et al. (2022)***. While ***Sanaei-Zadeh et al. (2011)*** reported that survivors group had prolonged delay period to mangement than non-survivors group.

The observed delay in seeking emergency assistance is related to the early symptomless interval as well as the methanol-induced latent symptoms. In this period, methyl alcohol is converted into formic acid causing fast deterioration ***(Azeemuddin and Naqi 2012; Desai et al. 2013)***.

The present study showed that mean systolic and diastolic blood pressure as well as temperature were significantly lower among non-survivors compared to survivors. Non-survivors had significantly higher respiratory rate than survivors. Moreover, there was highly statistical significant difference regarding occurrence of shock between survivors and non survivors. While no significant difference was detected regarding pulse between both groups.

This partially agrees with ***Sharif et al. (2021)*** who reported that the diastolic blood pressure revealed significant difference between favorable and unfavorable outcomes.

Also, ***Chang et al. (2019)*** demonstrated that, hypotension and hypothermia were common findings in methanol poisoned patients complicated by acute kidney injury with poor outcomes.

On the other hand, ***Elbastawesy et al. (2022)*** found insignificant difference between good and poor outcomes according to the vital signs measures.

Hypotension induced by methanol could be related to dehydration resulting from vomiting and methanol-induced depression of vasomotor center ***(Barceloux et al. 2002)***.

The most frequently reported symptom in the current study was vomiting (51.6%). While, seizures were the least frequent manifestation (14.1%) and there was highly statistical significant difference between survivors and non- survivors groups as regards the occurrence of seizures.

This was close to ***Sharif et al. (2021)*** and ***Elbastawesy et al. (2022)*** who reported that vomiting presented in 51.4% and 67.5% respectively. While, seizures were the least frequent manifestation presented in 18.9% and 7.5% respectively.

Also, ***Sharif et al. (2021)*** reported significant difference between favorable and unfavorable outcomes regarding occurrence of seizures (P= 0.008).

Previous research has shown a link between seizures and poor outcome, such as mortality ***(Sanaei-Zadeh et al. 2011; Lee et al., 2014)***.

The neurological impairments emerge from several areas of the brain, like the cerebral cortex, basal ganglion, hypothalamus and pons. Furthermore, hemorrhage, cerebral ischemia and cerebral edema have been identified in the post-mortem examination of mortalities from methyl alcohol poisoning ***(Paasma et al. 2012; Diagne et al. 2019)***.

In this study, there was highly significant difference between survivors and non-survivors as regards presence of coma.

The non-survivors had significantly lower mean GCS as compared to survivors. This was in accordance with ***Chang et al. (2019); Yousefinejad et al. (2020)*** and ***Elbastawesy et al. (2022)***.

There was in the study significant difference between survivors and non-survivors as regards visual manifestations and reported blindness in 12.5% of survivors group.

This goes in line with ***Elbastawesy et al. (2022)*** who reported significant difference between good and poor outcomes as regard presence of blurred vision.

Also, ***Hassanian-Moghaddam et al. (2007)*** and ***Ahmed et al. (2017)*** found blindness in 23% and 28% respectively of the exposed patients.

Methanol causes vision impairment by accumulating formic acid, which suppresses cytochrome oxidase enzyme and causes histotoxic hypoxia. Consequently, mitochondrial dysfunction and ATP depletion develop, interrupting action potential conduction and resulting in toxicity of the eyes and blindness ***(Barceloux et al. 2002).***

The current study revealed significantly lower levels of pH and Hco3 in non-survivors in comparison to survivors.

This was similar to ***Masoud et al. (2016); Kurtas et al. (2017); Chang et al. (2019)*** and ***Elbastawy et al. (2022)***. Unlikely, ***Yousefinejad et al. (2020)*** found that there were non-significant differences in pH and HCO3 values between good and poor outcome patients.

As regards anion gap in the present study, there was no significant difference was found between both groups.

This was in agreement with ***Mansour et al. (2018)*** who found no significant difference between Livings and Dead regarding anion gap.

On the other hand ***Elbastawy et al. (2022)*** and ***Sharif et al. (2021)*** reported significantly an increase in anion gap in poor and unfavorable outcome patients.

In this study, significantly higher base deficit, random blood sugar, blood urea nitrogen and serum creatinine levels were observed among non-survivors compared to those of survivors. ***Kurtas et al. (2017); Yousefinejad et al. (2020)*** and ***Elbastawy et al. (2022)*** also reported an elevation in random blood sugar and creatinine levels in patients with poor outcome.

Similarly, ***Mansour et al. (2018)*** found significant elevated base deficit, BUN and creatinine level among dead patients.

On contrary, ***Sharif et al. (2021)*** reported insignificant differences between favorable and unfavorable outcomes regarding RBS and creatinine level.

No significant difference was found between both groups as regards serum electrolytes (Na, K, Ca and Cl) or liver enzymes (AST and ALT)

This goes in line with ***Sharif et al. (2021)*** who reported insignificant differences between favorable and unfavorable outcomes regarding serum electrolytes, or liver enzymes.

Unlikely ***Elbastawy et al. (2022)*** reported that significantly increased liver enzymes levels in poor outcome patients.

As regards full blood count in this study, only platelet count was significantly higher in non-survivors in comparison to survivors. Significant prolonged P.T., PTT and INR was reported in non-survivors in comparison to survivors.

These results partially agree with ***Elbastawy et al. (2022)*** who revealed significantly prolonged P.T. and INR among the poor outcome group.

On other hand, ***Sharif et al. (2021)*** found insignificant difference between favorable and unfavorable outcomes regarding the hematological parameters and coagulation profile.

The current study reveals that mechanical ventilation was needed in 29.7% of total patients and highly significant difference was found between both studied groups as regards need for mechanical ventilation. Majority of total patients (59.4%) had initial severe PSS with high significant difference was found between both groups as regards PSS. Also, non-survivors scored significantly higher SOFA score than survivors.

These results are in agreement with ***Shaerif et al. (2021)*** who reported that unfavorable outcomes scored significantly higher SOFA score and majority of moderate and severe PSS cases showed unfavorable outcomes.

Also, ***Elbastawy et al. (2022)*** reported that most cases with moderate and severe PSS showed poor outcome.

In the current study, univariate analysis proves that systolic blood pressure ≤90 mmHg, diastolic blood pressure ≤60 mmHg, Temperature ≤36.5, Respiratory rate >28 cycle/min, occurrence of seizures and shock, GCS ≤9, presence of coma on admission, PH ≤7.01, HCO3 ≤7.7 mmol/L, base deficit >20.7 mmol/L, blood urea nitrogen >30 mg/dl, serum creatinine >1.6 mg/dl, random blood sugar >180 mg/dl, platelet count >345 INR >1.25, prothrombin time, >15 seconds, partial thromboplastin time >35 seconds, need for mechanical ventilation, severe PSS and SOFA >5 are significant mortality predictors. However, among the examined variables, multivariate analysis verifies that only SOFA score above 5 could significantly predict mortality in methanol intoxicated patients with 95.5% sensitivity, 97.6% specificity and an excellent AUC (0.989).

These findings were consistent with ***Shaerif et al. (2021)*** who reported that, the diastolic blood pressure, PSS, and SOFA scores were significant organ failure predictors. However, the SOFA score is the most accurate and early inclusive unfavorable outcome predictor.

In the same line, ***Mansour et al. (2018)*** concluded that, hypotension was strong indicator of fatality in the acutely methanol intoxicated individuals along with pH ≤ 6.79 and GCS score ≤7.

Similarly, ***Paasma et al. (2012)*** determined that low pH (pH<7) and coma

(GCS score <8) were the strongest predictors of poor outcome after methanol intoxication.

Also, ***Elbastawy et al. (2022)*** identified that, GCS was identified as potential predictive indicator of poor outcome patients in acute methanol intoxication.

Lee et al. (2014) reported that, GCS score was one of the most powerful risk variables for fatality.

Morteza et al. (2015) indicated that, high creatinine levels were an independent risk variable for alcohol-induced mortality, necessitating immediate hemodialysis.

The SOFA score was primarily used to assess sepsis patients, although reports have indicated that it was also used to evaluate poisoning patients. Individuals who have elevated SOFA scores are more susceptible to organ failure and death ***(Masson et al., 2012)***.

The SOFA score was reported to be outcome predictive in patients intoxicated by organophosphorus compounds ***(Moussa et al., 2018)*** with similar cutoff value (>5), aluminum phosphide ***(Sheta et al., 2019)*** and paraquat ***(Weng et al., 2013)***.

CONCLUSION

Acute methanol intoxication is a significant potentially fatal condition. Systolic blood pressure ≤90 mmHg, diastolic blood pressure ≤60 mmHg, temperature ≤36.5, respiratory rate >28 cycle/min, occurrence of seizures and shock, GCS ≤9, presence of coma on admission, PH ≤7.01, HCO3 ≤7.7 mmol/L, base deficit >20.7 mmol/L, blood urea nitrogen >30 mg/dl, serum creatinine >1.6 mg/dl, random blood sugar >180 mg/dl, platelet count >345 INR >1.25, prothrombin time, >15 seconds, partial thromboplastin time >35 seconds, need for mechanical ventilation, severe PSS and SOFA >5 are significant mortality predictors. However, the SOFA score is the early accepting and most accurate mortality predictor.

RECOMMENDATIONS

- Early detection of high-risk patients is essential and can save lives.
- Creating a tracking system to reduce illicit alcohol production.
- Raising public awareness of the dangers of illegal alcoholic beverages
- Predictors of mortality outlined in this study, particularly the SOFA score, should be evaluated frequently and as soon as possible to assess the severity and enhance the management approach.

Limitations of the study:

The study was carried out for a duration of two years. A longer period would, however, allow for more analysis of the methanol poisoning issue. The study only covered patients who presented to PCC-ASUH; other poison centers were not taken into account. Lack of methanol level measurement in the patients as well.

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التنبؤ بالوفاة فى التسمم االحاد بالكحول الميثيلي : دورمقياس شدة التسمم ومقياس تقييم فشل العضو المتسلسل

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الملخص العربى

المقدمة: يعد التسمم الحاد بالكحول الميثيلي مشكلة صحية خطيرة تؤثر على الناس في جميع أنحاء العالم وتتسبب في ارتفاع معدلات المراضة والوفاة.

الهدف: تهدف هذه الدراسة الى تحديد العوامل المتنبئة بالوفاة ودورمقياس شدة التسمم ومقياس تقييم فشل العضو المتسلسل كمؤشرات نتائج مبكرة بين المرضى الذين يعانون من التسمم الحاد بالكحول الميثيلي.

طريقة البحث: تم إجراء دراسة بأثر رجعي ومستقبلي على ٦٤ مريضًا بالتسمم الحاد بالكحول الميثيلي الذين تم استقبالهم بمركز علاج التسمم بمستشفيات جامعة عين شمس في الفترة من يناير ٢٠٢١ إلى ديسمبر ٢٠٢٢. حيث تم جمع البيانات مثل البيانات الشخصية الخاصة بالمرضى وتاريخ التعرض والنتائج السريرية ونتائج الفحوصات المخبرية. وتم عمل مقياس شدة التسمم ومقياس تقييم فشل العضو المتسلسل للمرضى.

النتائج: ومن بين ٦٤ مريضًا بالتسمم الحاد بالميثانول، كان ٢٢ مريضًا من المتوفيين. كان متوسط ضغط الدم الانقباضي والانبساطي وكذلك درجة الحرارة، ومقياس جلاسجو، ودرجة حموضة الدم ومستويات البيكربونات أقل بشكل ملحوظ بين مجموعة المتوفيين مع ارتفاع ملحوظ في معدل التنفس، والقصورالقاعدي، وسكر الدم العشوائي، وبولينا الدم، ومستويات الكرياتينين وعدد الصفائح الدموية والنسبة المعيارية الدولية وزمن البروثرومبين و زمن الثرومبوبلاستين الجزئي ومقياس شدة التسمم ومقياس فشل العضو المتسلسل. .

الاستنتاج: تظهر هذه الدراسة ان ضغط الدم الانقباضي و ضغط الدم الانبساطي و درجة الحرارة و معدل التنفس وحدوث تشنجات وصدمة ومقياس جلاسجو ووجود غيبوبة عند الحجز ودرجة حموضة الدم ومستويات البيكربونات والقصورالقاعدي وبولينا الدم، ومستويات الكرياتينين وسكر الدم العشوائي وعدد الصفائح الدموية والنسبة المعيارية الدولية وزمن البروثرومبين وزمن الثرومبوبلاستين الجزئي والحاجة الى التنفس الصناعى ومقياس شدة التسمم ومقياس فشل العضو المتسلسل من العوامل المتنبئة للوفاة فى التسمم الحاد بالميثانول. ومع ذلك، فإن مقياس فشل العضو المتسلسل هو المعيار المقبول مبكرًا والأكثر دقة للتنبؤ بالوفيات. وتوصى هذه الدراسة بانشاء نظام تتبع للحد من إنتاج الكحول غير القانونى وزيادة الوعي العام بمخاطر المشروبات الكحولية غير المشروعة.