Original Article

Accuracy of vital signs in early assessment of acute nephrotoxicity in acutely poisoned patients

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Abstract:

Introduction: Poisoning represents a public health problem. AKI and chronic kidney disease are known complications that can occur after acute poisoning with nephrotoxic drugs or poisons.

Aim Of the Work: Evaluation of the accuracy of vital signs as predictors of acute kidney injury (AKI) and outcome of acutely poisoned patients.

Methods: This prospective study was carried out on 100 acutely intoxicated patients by nephrotoxic drugs and poisons.

Results: 72% of the patients were men and 36% of the patients were between the ages of 18 and 30. AKI affected 21% of patients. Regarding the outcome, 43% of patients died or were discharged with issues requiring prolonged follow-up, whereas 57% of patients had recovered fully by the time they were discharged. Vital signs showed a non-significant difference between AKI groups and non-AKI patients' group. Systolic and diastolic blood pressure significantly differ between completely recovered and dead or complicated recovered patients. The Receiver Operating Characteristic Curve found that the systolic blood pressure below 95 mm/Hg had an accuracy rate of 65.2% with acceptable discrimination for mortality and morbidity, sensitivity of 55.8%, and specificity of 80.7%. Diastolic blood pressure below 55 mm/Hg had an accuracy rate of 64.6% with acceptable discrimination for mortality and morbidity, sensitivity of 46.5%, and specificity of 84.2%.

Conclusion: The study concluded vital signs can't be used as predictors for the incidence of AKI but systolic and diastolic blood pressure are accepted prognostic markers for the morbidity and mortality in acutely intoxicated cases with nephrotoxic drugs or poisons.

Introduction:

Poisoning is one of the most frequent reasons people visit hospitals for emergency care. Acute toxicity management is a significant medical issue worldwide. [1] In the current environment, many substances are harmful to the kidneys. Research is difficult because of their vast quantity and diversity, as well as their interactions with one another and the body's metabolism. Furthermore, the physiology of the kidney makes it particularly vulnerable to damage. Acute damage to the kidneys (AKI) caused by hazardous or mostly nephrotoxic chemicals can be obtained in the community, either nosocomial, ingestion, or inhalation. AKI can be brought on by a variety of nephrotoxic plants, animal poisons, pharmaceuticals, chemicals, and medications through different pathophysiological mechanisms. [2]

AKI is connected to several medications. Nonsteroidal anti-inflammatory drugs (NSAIDs), diuretics, antidepressants, intravascular contrast media, and cardiovascular treatments such as angiotensin-converting enzyme (ACE) inhibitors and angiotensin-receptor blockers (ARBs) are among the most common offenders. NSAIDs, ACE inhibitors, and ARBs that change blood flow to the kidneys can cause prerenal AKI. Since they cause direct damage to the kidneys, many of the others are categorized as intrarenal causes of AKI. Nephrotoxicity is more likely to occur when certain medications are taken often, in high dosages, or conjunction with other nephrotoxic medications. [3]

Measurement of vital signs is crucial in clinical assessment. Therefore, the prompt identification of any deviation in the patient's vital signs usually corresponds with the quick identification of changes in the patient's cardiopulmonary and renal state and, if necessary, the upgrading of the level of intervention. [1]

There is a shortage of studies that discuss acute kidney injury in acute poisoning. This study will discuss the importance of vital signs in AKI.

Aim Of the Work:

- Evaluation of the accuracy of vital signs as prognostic markers of AKI and outcome of acutely poisoned patients.

Methodology:

Type of study:

A prospective study from April 2021 to August 2021 which was carried out on one hundred acutely poisoned patients.

Patients:

One hundred intoxicated patients who met the study's inclusion requirements were chosen from among those who visited Sohag University Hospitals.

Criteria for inclusion:

Patients over the age of 18 who were hospitalized with acute poisoning symptoms caused by a medicine or toxin that had a nephrotoxic effect were included in the study.

Criteria for exclusion:

- ★ Less than eighteen years old patients
- ★ Pregnant cases
- ★ Patients had a history of any illness or condition that could affect the outcome of vital signs
- ★ Patients or first-degree relatives refused to participate in the study.
- ★ Asymptomatic cases

Methods of the study:

1- Each patient's demographic information (gender, age, kind and quantity of medication or toxin consumed, and the interval between toxin consumption and admission) was recorded on a prepared page.

2- Vital signs at the time of admission of patients to ICU or intermediate units were recorded.

3- AKI assessment which is defined by **Ali and Gray-Vickrey, (2011)** as a sudden (within 48 hours) decline in kidney function, which includes either a drop in urine output (less than 0.5 mL/kg/hour for more than 6 hours) or an increase in serum creatinine (either an absolute rise of greater than 0.3 mg/dL or a percentage increase of 50%).One To more accurately represent the range of kidney damage that results from several sources and can cause diseases ranging from moderate elevations in blood creatinine to acute renal failure (ARF). [3]

Statistical analysis:

Before being entered into a computer, the gathered data was coded and validated. The Statistical Package for the Social Sciences (SPSS) version 26 software was used to statistically evaluate the data that was gathered. The independent t-test was used to compare the groups based on numerical data. $P < 0.05$ denoted statistical significance in all analyses. The appropriate vital sign cut-off value for outcome prediction was established using a receiver operating characteristic (ROC) curve.

Ethical conditions:-

On November 4, 2021, ethical approval was received under IRB Registration number: Soh-Med- from the Medical Research Ethics Committee of the Faculty of Medicine at Sohag University following the commitment standard operating procedure standards. Before being included in the study, all patients or first-degree relatives had signed an informed written permission form, which they may accept or reject.

Results

This study was carried out on one hundred acutely intoxicated patients by nephrotoxic drugs admitted to Sohag University Hospitals. **Table (1)** showed that the age of the studied patients ranged from 18 to 58 years. With the age group 18-30 years old had the largest percentage with 36% of the total number of the patients followed by age group 31-45years represented 35% and group 45-58years 29%. As regard the gender, (72%) of the studied patients were males and (28%) were females.

Figure (1) showed different toxic agent with nephrotoxic impacts were involved in the study and the most common group recorded was paraphenylenediamine (PPD) 13%, followed by opiate 11% and organophosphorus and carbamate with percentage 11%, then methanol 7%, tramadol and analgesics 6% of each of them.

According to **table (2),** the majority of the patients in the study were exposed to medications and poisons orally (77%) and by injection (16%). **Table (2)** indicates that, in terms of poisoning purpose, the majority of cases were intentional (37%) and overdose mode (28%).

Vital signs in the studied patients as shown in **table (3)** were as follow, pulse range from 38 to 150 beats per minute with mean 89.9± 26. Systolic blood pressure mean 101.8±23mm/Hg and diastolic blood pressure 64.1±14.7, temperature 36.9±0.7 C° and respiratory rate 15.5 ±8.2 rate per minute.

Figure (2) showed that 21% had AKI according to the AKI assessment criteria and 79% didn't have.

Table (4) showed that there is no significant difference of vital signs between AKI group and non-AKI group P value >0.05.

The outcome of the studied patients presented in **table (5),** 57% of the studied patients had complete recovery. 43% of the studied patients died or had complications to be followed up.

As regard relationship between outcome of the patients' vital signs **table 6** showed significant difference between systolic and diastolic blood pressure in complete recovered cases and dead and complicated recovered cases as P<0.05. While, no significant difference between the 2 groups regarding other vitals pulse, temperature and respiratory rate as P>0.05.

Table (7) and figure (3) illustrated ROC curve analysis to assess the predictors of mortality and morbidity found that the systolic blood pressure below 95 mm/Hg had an accuracy rate of 65.2% with acceptable discrimination for mortality and morbidity, sensitivity of 55.8%, specificity of 80.7%. Diastolic blood pressure below 55 mm/Hg had an accuracy rate of 64.6% with acceptable discrimination for mortality and morbidity, sensitivity of 46.5%, specificity of 84.2%.

Table (1): Age and gender distribution of the studied patients

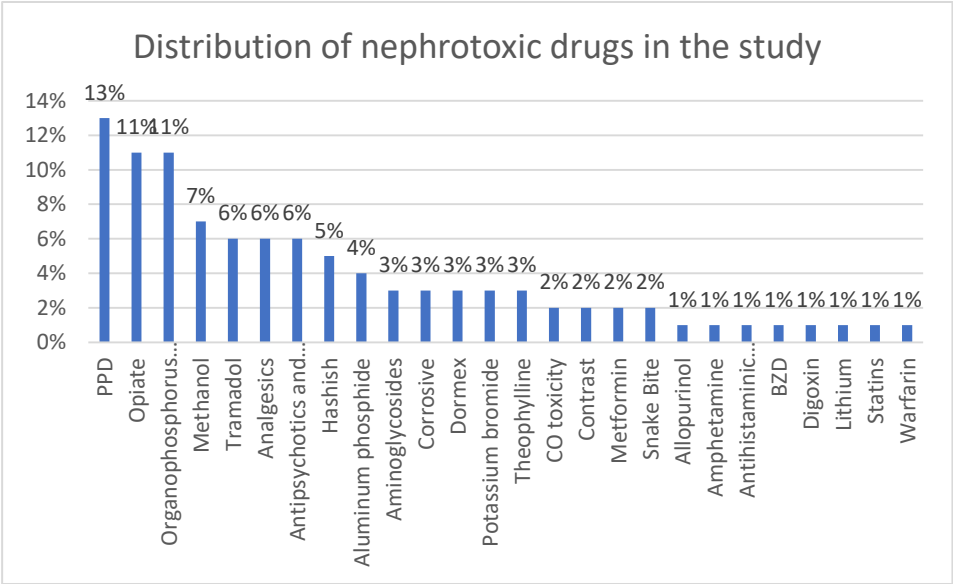| Age groups (years)	Number	Percentage (%)	
18-30years	36	36%	
31-45years	35	35%	
45-58years	29	29%	
Total	100	100%	
Median (IQR)= 35.5 (26:47.7) years Range: 18:58 years			
Sex		**Number**	**%**
Males		72	72%
Females		28	28%
Total		100	100%

**Figure (1):** Bar chart showing nephrotoxic drug percentages among the study population.

Table (2): Percentage distribution of route of exposure and intention of poisoning among studied population

Route of exposure	Number	%
Oral	77	77
Injection	16	16
Inhalation	2	2
Bite	2	2
Dermal	3	3
Total	100	100
Intention of poisoning	Number	%
Suicidal (Intentional)	37	37
Accidental	20	20
Overdose	28	28
Iatrogenic	11	11
Homicidal	4	4
Total	100	100

Table (3): vital signs of acutely intoxicated cases by nephrotoxic drugs under the study.

Pulse (beats/min)	
Mean ± SD	89.99 ± 26.07
Range	38 – 150
Systolic blood pressure by mm/Hg	
Mean ± SD	101.8 ± 23.02
Range	60 – 150
Diastolic blood pressure by mm/Hg	
Mean ± SD	64.1 ± 14.71
Range	30 – 90
Temperature (°C)	
Mean ± SD	36.93 ± 0.75
Range	35 – 40
Respiratory rate per minute	
Mean ± SD	15.58 ± 8.24
Range	6 – 40

SD: standard deviation
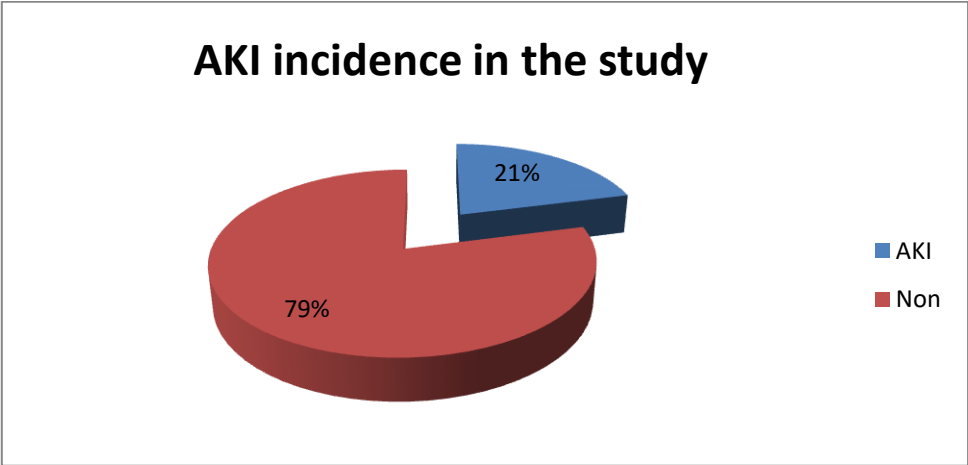
Figure(2): Pie chart shows percentage of incidence of AKI among studied population

Table (4): Vital signs comparison between AKI group and non-AKI group:

Variable		AKI patients	Non-AKI patients	Independent t-test
		N=21	N=79	p-value
Pulse	Mean± SD	81.05 ± 16	92.3±27.7	0.07 NS
Systolic blood pressure	Mean± SD	105.7±19.6	100.7±23.8	0.4 NS
Diastolic blood pressure	Mean± SD	65.2±12.9	63.8±15.2	0.7 NS
Respiratory rate	Mean± SD	13.4±5.2	16.2±8.7	0.1 NS
Temperature	Mean± SD	36.8 ±0.4	36.9±0.8	0.4 NS

*P < 0.05 (significant)   NS: Non-significant P > 0.05   SD: Standard deviation

Table (5): The outcome of the studied patients.

Outcome	Percentage	Outcome	Number	Percentage %
Complete recovery	57%	Complete recovery	57	57%
Mortality or complications	43%	Chronic kidney disease	8	8%
		Partial recovery with follow up	4	4%
		Died	31	31%
Total	100		100	100%

**Table (6): Vital signs comparison between complete recovered group and complicated and dead group:**

Variable		Complete recovered patients	Complicated and dead patients	Independent t-test
		N=57	N=43	p-value
Pulse	Mean± SD	89.04 ± 21.5	91.2±31.3	0.6 NS
Systolic blood pressure	Mean± SD	107.1±19.1	94.6±25.8	0.006*
Diastolic blood pressure	Mean± SD	67.3±12.7	59.7±16.1	0.01*
Respiratory rate	Mean± SD	16±7.8	15.1±8.6	0.5 NS
Temperature	Mean± SD	36.8 ±0.6	36.9±0.8	0.6 NS

*P < 0.05 (significant)   NS: Non-significant P > 0.05   SD: Standard deviation

Table (7): Sensitivity, specificity and accuracy rate of diastole and systole as predictors of morbidity & mortality in the studied patients

Variable	Cut off point	AUC (Area under the curve)	p-value	Sensitivity (%)	Specificity (%)	Accuracy rate
Diastole	≤55	0.646	0.013*	46.5%	84.2%	64.6%
Systole	≤95	0.652	0.010*	55.8%	80.7%	65.2%

*P < 0.05 (significant)
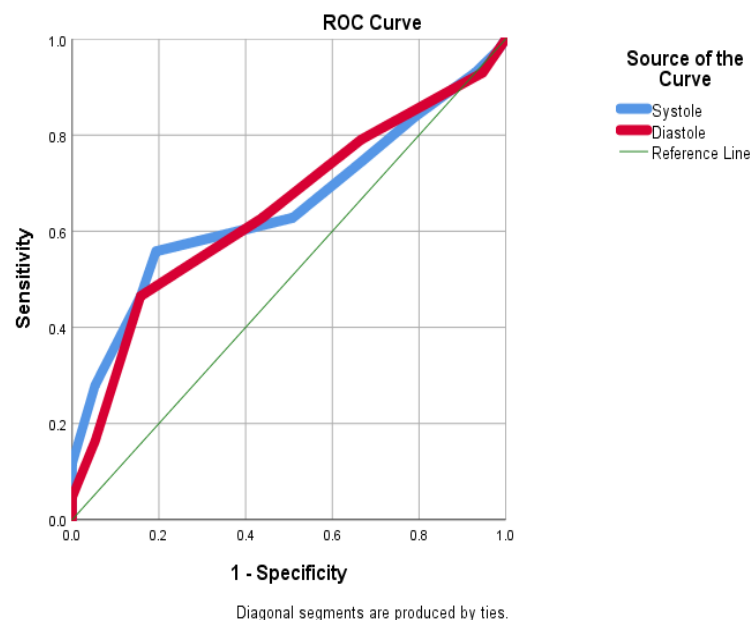
Figure(3) ROC curve of systolic and diastolic blood pressure as predictor of mortality and morbidity

Discussion:

This prospective study was carried out on 100 acutely poisoned patients with nephrotoxic poisons admitted to Sohag Hospitals during April 2021 to August 2021.

The age of the studied patients ranged from 18 to 58 years. With the age group 18-30 years old had the largest percentage with 36% of the total number of the patients followed by age group 31-45years represented 35% and group 45-58years 29%. As regard the gender, (72%) of the studied patients were males and (28%) were females. Different toxic agent with nephrotoxic impacts

were involved in the study and the most common group recorded was paraphenylenediamine (PPD) 13%, followed by opiate 11% and organophosphorus and carbamate with percentage 11%, then methanol 7%, tramadol and analgesics 6% of each of them.

In the study by **Naqvi (2017)** who studied 184 cases with AKI in Pakistan and found the mean age 24 years and males to females' ratio are nearly equal and PPD represent the most common agent in 135 AKI cases in his study. [4]

In the study conducted by **Abdelkader et al. (2023)** on PPD toxicity cases in Sohag University hospitals found that females are more affected than males regarding PPD toxicity and cause in majority of cases nephrotoxicity

In terms of exposure route, the majority of the patients in the study were exposed to medications and toxins orally (77%) and by injection (16%). Intentional poisoning accounted for 37% of instances, with overdose mode coming in second (28%). This is comparable to **Shokry et al. (2021),** who found that the primary route of toxicity was oral consumption and that the most frequent reason for acute poisoning cases brought to the intensive care unit was suicidal poisoning attempts. [1]

Vital signs in the studied patients were as follow, pulse range from 38 to 150 beats per minute with mean 89.9± 26. Systolic blood pressure mean 101.8±23mm/Hg and diastolic blood pressure 64.1±14.7, temperature 36.9±0.7 Cº and respiratory rate 15.5 ±8.2 rate per minute. There was no significant difference of vital signs between AKI group and non-AKI group P value >0.05.

This nearly like **Mood et al. 2011** that acute intoxicated patients no significant difference between

survivors and non survivors regarding pulse temperature and respiratory rate. [5]

The outcome of the studied patients, 57% of the studied patients had complete recovery. 43% of the studied patients died or had complications to be followed up.

This was nearly similar to **Khalil et al. (2021)** 51.4% had complete recovery, 5.7% developed chronic kidney disease and 42.8% died. [6]

As regard relationship between outcome of the patients and vital signs, there was significant difference between systolic and diastolic blood pressure in complete recovered cases and dead and complicated recovered cases as P<0.05. While, no significant difference between the 2 groups regarding other vitals pulse, temperature and respiratory rate as P>0.05

ROC curve analysis to assess the predictors of mortality and morbidity found that the systolic blood pressure below 95 mm/Hg had an accuracy rate of 65.2% with acceptable discrimination for mortality and morbidity, sensitivity of 55.8%, specificity of 80.7%. Diastolic blood pressure below 55 mm/Hg had an accuracy rate of 64.6% with acceptable discrimination for mortality and morbidity, sensitivity of 46.5%, specificity of 84.2%.

The prognosis was poorer for patients with high vital signs than for those without them. A person is at a higher risk of dying if their temperature is higher than 39, their respiratory rate is greater than 20, their heart rate is less than 35 or more than 120 beats per minute, and their systolic blood pressure is less than 100 or larger than 150. [7]

In contrary to us, **Assaf et al. (2019)** found that respiratory rate, blood pressure and pulse can be used as predictors of mortality and morbidity in acute intoxicated patients. [8]

The most important one of vital signs measurements to predict mortality in acute poisoning is blood pressure especially when you see hypotension. [9]

Conclusion:

The study concluded that all vital signs can't be used as predictors for incidence of AKI but systolic and diastolic blood pressure respectively are accepted prognostic tools for the morbidity and mortality in acutely poisoned patients with nephrotoxic drugs or poisons.

References:

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