Original Article

Role of Liver Function Tests and Serum Lactate Levels in Predicting the Severity of Acute Paraquat Poisoning

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Abstract

Introduction: The paraquat is a liquid herbicide associated with both accidental and intentional ingestion, leading to severe and often fatal toxicity.

Aim: The present study is to evaluate the role of liver function tests and lactate levels in predicting the outcome of acute paraquat poisoning.

Materials and Methods: A total of 30 patients with acute paraquat poisoning admitted in intensive care unit (ICU) were included in the study. The paraquat poisoning was confirmed by urine dithionite test. Initial clinical parameters such as vital signs, age, amount of paraquat consumption, respiratory rate, serum creatinine, bilirubin, alanine transaminase (ALT), aspartate transaminase (AST), and lactate levels were obtained at the time of admission to ICU. Depending on the outcome after paraquat poisoning the patients were categorized as survivors and non-survivors, the trend in the clinical parameters was assessed to observe the severity.

Results: The overall mortality rate was 66.6% (20/30) during 3 days follow-up, on the 1st day of admission serum bilirubin, AST, ALT, and lactate levels were statistically significantly high in non-survivors when compared with survivors.

Conclusion: The 1st day of admission serum bilirubin, AST, ALT, and lactate levels are very much elevated and are useful in predicting the outcome of paraquat poisoning.

Key words: Acute paraquat poisoning, Predictors, Outcome, Survivors

INTRODUCTION

Paraquat also known as gramoxone is an organic nitrogen heterocyclic herbicide used in agriculture throughout the world. Its active component is the 1, 1'dimethyl-4, 4'dipyridine cationic compound.[1,2] It is highly toxic to the humans; intentional or accidental ingestion of paraquat is frequently fatal due to the failure of multiple organs.[3] An estimated of 250,000 to 370,000 people die all over the world from pesticide poisoning each year, and around 90% of the patients with paraquat poisoning had taken concentrate paraquat in liquid form orally.[4] Many critical care practitioners tried different therapeutic modalities for the management of acute paraquat poisoning cases, but still high mortality rate is see.[5] Hence, reliable predictors are required for assessing the severity of acute poisoning, which help in framing proper treatment plans to have a better outcome. So far, several markers have been reported to assess the severity including plasma paraquat concentration, Apache II, SOFA score, and estimated ingestion dose of paraquat;[6] out of these, the best marker is plasma paraquat concentration, but the estimation of plasma paraquat concentration is more complicated process which requires expensive equipment and good quality controls.[7]

Therefore, alternative clinical markers which are cheaper and possess' good quality controls are required to predict

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the severity of acute paraquat poisoning. The aim of the present study is to evaluate the importance of less expensive serum bilirubin, aspartate transaminase (AST), alanine transaminase (ALT), and lactate levels on the 1st day of admission in intensive care unit (ICU) for predicting the severity of acute paraquat poisoning.

MATERIALS AND METHODS

The present study was approved by the institutional ethics committee of NRI Medical College and Hospital. This is a prospective study of patients with acute paraquat poisoning admitted to ICU from January 2011 to January 2015. A total number of 30 patients included in the study, who met with the following criteria: (1) Patients had a history of attempted suicide through paraquat ingestion with circumstantial evidence such as empty paraquat container, (2) patients who tested positive in urine dithionite test for acute paraquat poisoning and displayed typical clinical features such as vomiting, oral ulcers, and difficulty in swallowing. Patients were excluded if they had chronic liver disease, chronic kidney disease, diabetes, and drunken alcohol before the ingestion of paraquat. All the patients were given standard treatment protocol. Initial biochemical parameters such as serum creatinine, bilirubin, ALT, AST, and lactate levels were analyzed at the time of admission to ICU i.e., on the 1st day of admission by collecting 5 ml of blood sample from all the patients using Dade dimensions auto analyzer after standardizing the above said parameters using Bio-Rad quality controls. The same parameters were measured on the 2nd and the 3rd day also. The patients were categorized as survivors and non-survivors depending on whether they survived after a follow-up of 3 days; the trend in the biochemical parameters were assessed to observe the severity. The data were presented as a mean ± standard deviation for continuous variables and frequency in percentage for a categorical variable. A $P < 0.05$ was considered a statistically significant.

RESULTS

A total number of 30 patients with acute paraquat poisoning who were admitted to ICU from January 2011 to January 2015 were included in the study. Of 30 patients, the survivors were 33.3% and non-survivors 66.6%, the mean serum creatinine in survivors was 1.3 mg/dl ± 1.6 and in non-survivors was 2.3 mg/dl ± 2.1 with a $P < 0.005$. The mean serum total bilirubin in survivors was 0.9 mg/dl ± 0.16 and in non-survivors was 3.1 mg/dl ± 1.19 with a $P < 0.005$. The mean serum ALT in survivors was 34.4 IU/L ± 60.1 and in non-survivors was 64.5 IU/L ± 110.6 with a $P < 0.005$. The mean serum AST in survivors was 38.2 IU/L ± 66.5 and in non-survivors

were 69.4 IU/L ± 120.8 with a $P < 0.005$. The mean serum lactate in survivors was 26.1 mg/dl ± 10.8 and in non-survivors was 72.7 mg/dl ± 20.2 with a $P < 0.005$ (Table 1).

Graph: 1 shows significant rise of Serum bilirubin levels in non survivors when compared to survivors. Graph: 2 shows significant rise of Serum alanine transaminase levels in non survivors when compared to survivors. Graph: 3 shows significant rise of Serum aspartate transaminase levels in non survivors when compared to survivors. Graph: 4 shows significant rise of Serum lactate levels in non survivors when compared to survivors.

It is observed that the mean serum lactate levels were significantly increased from the 1st day to the next 2 days in non-survivors, whereas in survivors the mean serum lactate levels were significantly decreased. (Graphs 5 and 6)

DISCUSSION

The aim of this study was to identify the reliable predictors to assess the severity of paraquat poisoning. Paraquat poisoning is a significant cause of death around the world.[8] The severity of paraquat poisoning may depend on the amount of the paraquat exposure, absorption, and vulnerability of an individual. Many studies revealed various predictors which assess the severity of paraquat poisoning.[9-11] Our study revealed a new relation between initial clinical parameters such as total bilirubin, AST, ALT, and lactate levels on admission and survival of the patient. The toxicity of paraquat is through redox cycling, leading to generation of superoxide anions. These may react to form hydrogen peroxide and subsequently the highly reactive hydroxyl radical, which is thought to be responsible for lipid peroxidation and cell death.[12] Systemic effects of paraquat poisoning are renal and hepatic failure, pulmonary edema and fibrosis, cardiac failure, shock, convulsions, and multi-organ failure. In our study, serum total bilirubin, AST, and ALT were elevated very much in non-survivors compared to survivors shows that liver is affected immediately after paraquat ingestion which highlight the importance of LFT in acute paraquat poisoning which go in accordance with
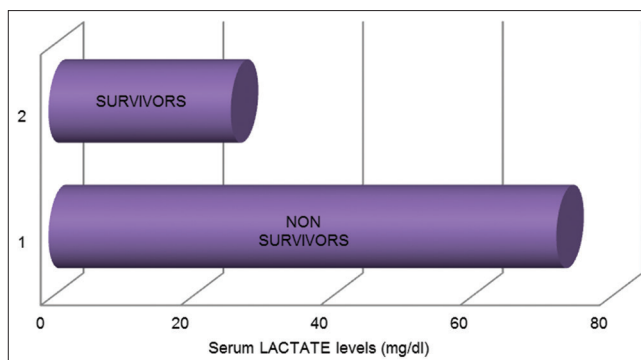
Table 1: Comparison of initial parameters of 30 paraquat poisoning cases on the 1st day of admission between non-survivors and survivors

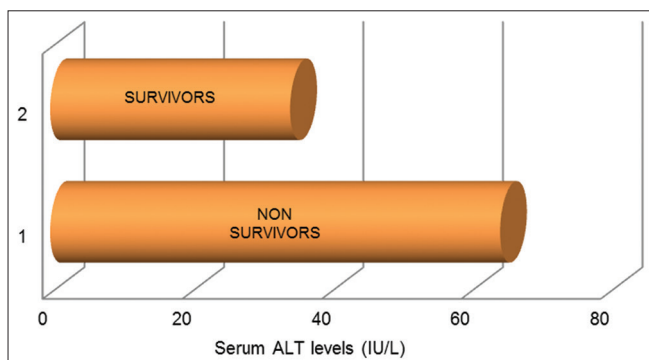| Parameters	Non-survivors (*n*=20)	Survivors (*n*=10)	*P* value
Creatinine (mg/dl)	2.3±2.1	1.3±1.6	<0.005
Total bilirubin (mg/dl)	3.1±1.19	0.9±0.16	<0.005
ALT (IU/L)	64.5±110.6	34.4±60.1	<0.005
AST (IU/L)	69.4±120.8	38.2±66.5	<0.005
Lactate levels	72.7±20.2	26.1±10.8	<0.005

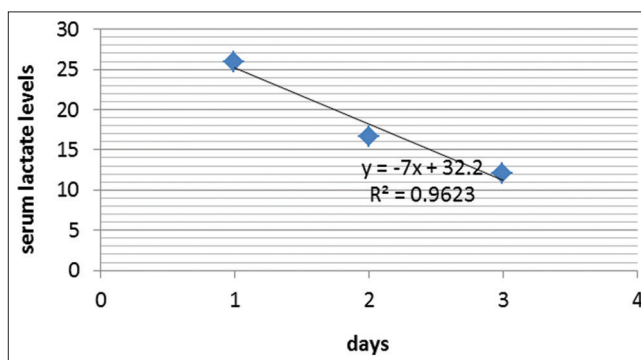ALT: Alanine transaminase, AST: Aspartate transaminase
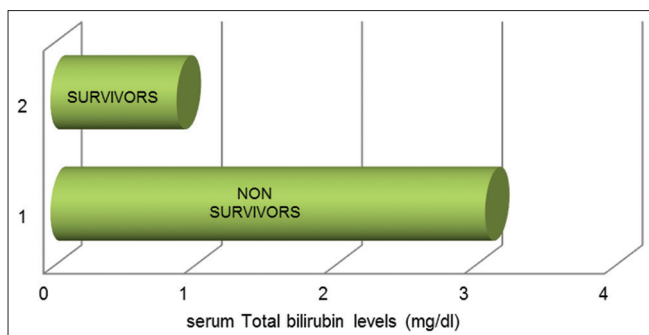
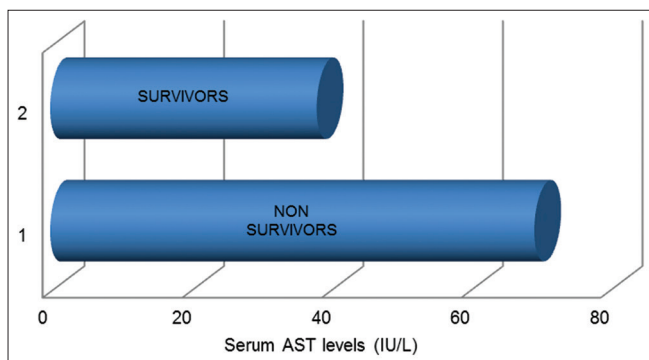**Graph 1:** The mean initial serum total bilirubin levels in non-survivors were significantly higher than survivors

Graph 2: The mean initial serum alanine transaminase levels in non-survivors were significantly higher than survivors

Graph 3: The mean initial serum aspartate transaminase levels in non-survivors were significantly higher than survivors

Graph 4: The mean initial serum lactate levels in non-survivors were significantly higher than survivors
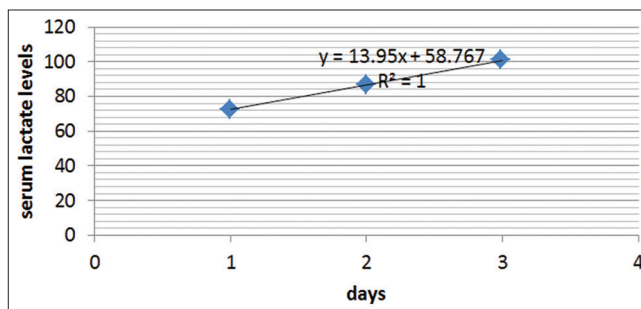

$y = -7x + 32.2$
$R^2 = 0.9623$

Graph 5: The rate of decrease in the mean serum lactate levels on the 1st, 2nd, and 3rd day in survivors

$y = 13.95x + 58.767$
$R^2 = 1$

Graph 6: The rate of increase in the mean serum lactate levels on the 1st, 2nd, and 3rd day in non-survivors

other studies stating that substantial proportion of paraquat patients suffered from hepatic complications[13] and liver may show pallor, mottled appearance and fatty changes due to microscopic centrilobular necrosis.[14] In our study, serum lactate levels at the time of admission were elevated very much in non-survivors when compared to survivors which shows the anoxic conditions of various tissues, highlights the importance of serum lactate levels in predicting the severity of acute paraquat poisoning, which in accordance with other researchers stating that initial lactate levels were higher in non-survivors than in survivors.[15] It was also observed that the other initial clinical parameters such

as blood pH, respiratory rate, and serum creatinine were associated with the survival after acute paraquat poisoning.

CONCLUSION

Paraquat consumption is a common agent of suicidal poisoning in this part of India, resulting in very high mortality. As there is no specific antidote for paraquat poisoning, the mainstay of treatment is supportive. In this situation, predictors for severity of acute paraquat poisoning play a major role in determining the prognosis. Our results suggest that initial clinical parameters such as serum total bilirubin, AST, ALT, and lactate levels are very

good predictors to assess the outcome of acute paraquat poisoning.

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