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A study of acute kidney injury in different poisoning cases in Bundelkhand region

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ABSTRACT

Background: In Bundelkhand region, 15–18% of patients who are attended in the emergency setting comprises poisoning, 60–70% of which are agriculture-based poisons due to its easy accessibility. The chief complication of poisoning is acute kidney injury (AKI). **Aims and Objectives:** The aim of the study was to find out the proportion of AKI in acute poisoning, the spectrum of clinical features and their complications and outcome. **Materials and Methods:** The cross-sectional study was performed in patients admitted in Departments of Medicine, MLB Medical College and Hospital, Jhansi over a period of 25 months (December 2020–October 2022). **Results:** In our study, there were 100 patients, 83% developed pre-renal AKI and 17% landed up into acute tubular necrosis. Maximum patients recovered, but 13 patients deteriorated, in which most presented after a lag time of 12 h of poison exposure, during the course of management, 5 patients required dialysis (3 peritoneal/2 hemodialysis). Out of 13 Patients, 11 expired and 2 improved, most of them consume celphos and insecticide. **Conclusion:** Our study shows that agriculture-based chemicals are easily available and accessible for poisoning. The time lag in proper treatment and detoxification leads to various complications; an early intervention and appropriate antidote easily reverses complications and end-organ damage, whereas some cases require dialysis or ventilator support. Middle-aged male, low socioeconomic economic groups, and psychiatric issues lay as background for most poisoning cases, where financial deprivement, lack of knowledge, and awareness have major issues.

Key words: Poisons; Acute kidney injury; Hair dye poisoning

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INTRODUCTION

Poison is any substance which if introduced into the living body or brought in contact produces ill health or death by its systemic or local effects or both. They are inert substances, of which even minimal concentration upon consumption causes adverse outcomes with mortality at times. There are certain substances which in certain fixed amount acts as therapeutic agents and in large doses as toxins. Individual response to a given dose may vary because of genetic polymorphism, enzymatic induction or inhibition in the presence of other xenobiotics or acquired tolerance.[1]

There are several substances that are hazardous to the kidney. The physiology of the kidney makes it particularly vulnerable to injury. Acute kidney injury (AKI) occurs by toxins or nephrotoxic chemicals through ingestion, inhalation, or nosocomial exposure. Numerous nephrotoxic plants and animal poisons, pharmaceuticals, chemicals, and illegal substances can cause AKI through various pathophysiological mechanisms.[2]

AKI is defined by the impairment of kidney filtration and excretory function over days to weeks, resulting in the retention of nitrogenous and other waste products that are normally cleared by the kidneys. AKI is not a single disease but rather a designation for a heterogeneous group of conditions that share common diagnostic features: Specifically, an increase in serum creatinine (S.Cr) concentration often associated with a reduction in urine volume. In addition, the epidemiology of toxic AKI differs

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by nations, regions within a nation, socioeconomic position, and access to the medical resources.[1]

Correlation of poisoning and AKI[1]

Toxin-induced TIN is the second most common cause of acute injury after pyelonephritis in these ways:

1. Ischemic necrosis of tubular epithelial cells causing AKI
2. Direct toxic injury to tubules and its cells
3. Rhabdomyolysis
4. Intestinal immunological reaction by acute hypersensitivity.

Spectrum of AKI[1]

Pre-renal AKI involves no parenchymal damage to the kidney and is rapidly reversible once parenchymal blood flow and intraglomerular hemodynamics are restored. Prolonged periods of pre-renal AKI may lead to ischemic injury to the tubular cells with necrosis, hence termed acute tubular necrosis. Survivors of an episode of AKI requiring temporary dialysis and high-risk progress to chronic kidney disease and up to 10% may develop ESKD requiring dialysis or transplantation.

Aims and objectives

1. To find out the proportion of AKI in acute poisoning cases admitted in our tertiary health care center
2. To study the spectrum of clinical features in patients presenting with AKI due to acute poisoning
3. To determine the complications and outcome of patients developing AKI due to various acute poisoning.

MATERIALS AND METHODS

The cross-sectional prospective study was conducted in 10 cases of AKI in different poisoning cases in Bundelkhand region in patients admitted in Department of Medicine, Maharani Laxmi Bai Medical College, Jhansi, Uttar Pradesh between December 2020 and October 2022.

Inclusion criteria

- Patients having a history of poison ingestion and were above 16 years.

Exclusion criteria

- Comorbidities such as diabetes mellitus, hypertension, and kidney disease
- AKI after snake bite or scorpion stings
- Chronic non-steroidal anti-inflammatory drug abuse
- Drug-induced renal failure.

Methodology

Patients were enrolled in the trial after receiving documented parental or caregiver consent. Written informed consent was obtained from all the study patients or a legally authorized representative (if the patient could not consent).

Laboratory investigations included hemoglobin, total and differential leukocyte counts, platelet counts, red cell counts, bleeding and clotting time, coagulation profile including prothrombin time, activated partial thromboplastin time and international normalized ratio, urine microscopy, urine albumin, kidney and liver function tests, and serum electrolytes.

Radiological investigations included X-ray chest and ultrasonography of abdomen.

Diagnosis of AKI

As mentioned, the diagnosis of AKI is generally based on the measurement of:

- Increase in serum creatinine
- Decreased urine output.

RESULTS

In our study, total 100 cases of poisoning were taken, out of which maximum number of cases were in the age group of 31–35 years (31%) (Table 1). Out of the 100 study participants, 64 (64%) were male and 36 (36%) female, majority 42% belonged to middle class (Table 2). The majority of them consumed insecticide 20 (20%), celphos 17 (17%), rat killer and hair dye 16 (16%), herbicide 15 (15%), alcohol Intoxication 9 (9%), and other toxin 7 (7%) being the common poisons.

DISCUSSION

In our study, total 100 cases of poisoning were taken, out of which maximum number of cases were in the age group of 31–35 years (31%). In our research we found that, insecticide 20 (20%) was most commonly used poison,

Table 1: Distribution of study participants in terms of age (n=100)

Age group	Number of patients	Percentage
16–20	11	11
21–25	12	12
26–30	16	16
31–35	31	31
36–40	6	6
41–45	13	13
46–50	6	6
51–55	5	5

Table 2: Distribution of study participants in terms of gender (n=100)

Gender	Number of patients	Percentage
Male	64	64
Female	36	36
Total	100	100

Table 3: Prevalence of acute kidney injury among study participants (n=100)

Prevalence	Number of patients	Percentage
Acute kidney injury	13	13
No complications	87	87

Table 4: Distribution of study participants with AKI according to the different poisonings (n=13)

Poisoning	AKI (n=13)	%
Celphos	4	30.76
Insecticidal	3	23.07
Rat killer	3	23.07
Hair dye	1	7.69
Herbicide	1	7.69
Alcohol intoxication	1	7.69

AKI: Acute kidney injury

followed by Celphos 17 (17%), rat killer 16 (16%), hair dye 16% (16%), herbicide 15 (15%), alcohol intoxication 9 (9%), and other toxins 7 (7%) among study participants.

Organophosphate and Celphos are the two common pesticides whose poisoning is prevalent throughout the country and we have found similar picture of age group, gender ratio, and type of poison when we compared studies of Katariya et al.[3]

In our study, 4 (30.76%) out of 13 cases of aluminum phosphate had AKI (Table 3). Celphos is highly poisonous and releases the phosgene gas when exposed to moisture. This gas is easily absorbed through inhalation, ingestion, or cutaneous contact.

Our study found that 3 (23.07%) cases of insecticide poisoning had AKI. Few studies on the association between OP poisoning and AKI have been published (Table 4). Faiz et al.[4] surveyed 300 patients with OP poisoning in an intensive care unit and reported that only 1.66% of them had acute renal failure.

The study shows that 3 (23.07%) patients of rat killer ingestion had AKI (renal injury). The clinical signs and symptoms of zinc phosphide poisoning are also identical to those of aluminum phosphide poisoning; however, the onset is delayed. The study illustrates that nausea (98%) and vomiting (80%) are early features after ingestion which is in accordance with the study of Chugh et al.,[5] according to which profuse vomiting, abdominal pain, palpitation, sweating, tachypnea, and dyspnea are the most common presenting features. Moreover, 8.62% are suffering from renal injury, and the similar findings have seen in a study by Chugh et al.,[5] where the unusual complication of phosphide ingestion including acute renal failure rhabdomyolysis, pleural effusion, hemorrhage, and necrosis is also evident.

Table 5: Distribution of study participants with acute kidney injury in terms of complication (n = 13)

Complications	Number (n = 13)	%
Decreased urine output	10	76.92
Sepsis	9	69.23
Shock	9	69.23
Gastritis	9	69.23
Uremic encephalopathy	7	53.84
ARDS	6	46.15
Anuria	6	46.15
Myocarditis	3	23.07

Table 6: Distribution of study participants with AKI in terms of outcome (n=13)

Outcome	AKI (n=13)	%
Expired	11	84.61
Improved	2	15.38

AKI: Acute kidney injury

In our study, hair dye poisoning contributed only 1 (7.69%) case, out of 13 AKI cases (Table 4). In a study conducted by Kallel et al.,[6] the number was significantly higher which was 47.7%. Oliguria and fluid overload which is represented by the edema over the face are the visible symptoms, which were found in the study. In a study by Ram et al.,[7] physical manifestations include cervical and upper respiratory tract edema, muscle edema, rhabdomyolysis, and oliguric AKI, whereas in another study by Ashar[8] symptoms include angioedema of the face and neck with difficulty breathing, secondary to the upper respiratory tract edema, and chocolate brown urine, confirming evidence of hair dye poisoning.

In our study, according to the complications in AKI patients, decreased urine output was the most common symptom reported in 10 (76.92%) of patients, followed by sepsis in 9 (69.23%). Shock was present in 9 (69.23%) patients, so was gastritis 9 (69.23%). Other prominent complications were uremic encephalopathy 7 (53.84%), anuria 6 (46.15%), ARDS 6 (46.15%), and myocarditis 3 (23.07%), out of 13 AKI patients (Table 5).

In our study participants with AKI in terms of outcome, 11 (84.61%) expired and 2 (15.38%) improved (Table 6), in which it is found that patients who have consumed celphos and pesticides and who were more hemodynamically unstable, with severely deranged ABG profiles with sepsis and shock, were more prone for mortality. In a study conducted by Yadav et al., 2018[9] and Mohammad Arefi et al., 2014[10], it has similar picture.

Limitations of the study

The study performed was a single-centered study.

CONCLUSION

Agriculture-based chemicals (organophosphates and aluminum phosphide) are most common substances for poisoning. They are easily accessible substances for suicidal, homicidal, or recreational poisoning. Psychiatric issues, illiteracy, and low socioeconomic status are found to have been background for most poisoning cases. The time lag in proper treatment may lead to various complications such as AKI where some patients need hemodialysis and ventilator support. Early interventions such as gastric lavage, antidote, and fluid management reverse various harmful effects of poisoning. Therefore, government should emphasize on training of CHC and PHC personnel for effective primary treatment. Doctors should ensure counseling and follow-up of the psychiatric patients with poisoning which is an important aspect of its management.

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