

ORIGINAL RESEARCH

**Acute Kidney Injury in Children with Snakebite Evenomation in a Tertiary Care Hospital**

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**ABSTRACT**

**Background:** Acute kidney injury (AKI) is a life-threatening systemic effect of snake envenomation. Monitoring of blood pressure, fluid balance, serum creatinine, blood urea nitrogen and serum electrolytes is useful in managing AKI induced by snake envenomation. Antisnake venom is the effective treatment to prevent or reverse most of the harmful effects of snakebite envenomation. Objectives: • To study the prevalence, the predictors and the outcome of AKI in children with snakebite evenomation

**Methods:** A cross sectional study was conducted on 100 children admitted with snake bite evenomation to PICU at Niloufer hospital from July 2020 to June 2022, satisfying the inclusion criteria were enrolled in the study.

A detailed history and systemic examination was done and it was recorded in a predesigned structured proforma. The relevant blood investigations were done. AKI was defined as per KDIGO guidelines based on Serum creatinine values and urine output.

**Results:** The prevalence of AKI was 18%, out of which 38.88% were prerenal and 61.11% were intrinsic renal. Patients belonging to rural areas, with longer time taken for admission, blood urea and serum creatinine levels at the time of admission were found to be the significant predictors of AKI. Higher serum potassium levels and requirement of ionotropes were also significantly higher in patients with AKI. Mortality was present in 3 children who developed AKI (16.66%). These deaths were due to Multiple Organs Dysfunction Syndrome (MODS).

**Conclusion:** Area of residence, time taken for admission, serum potassium, blood urea, serum creatinine levels at admission were the strong predictors of AKI. Early hospitalization, quick ASV administration and adequate supportive care were associated with good outcome.

**Keywords:** Snake bite, Acute kidney Injury, Anti snake venom, serum potassium, Predictors, Outcome

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## **INTRODUCTION**

As per WHO, approximately 5 million snakebites occur annually, leading to as many as 2.7 million cases of envenomation. An estimated annual death toll ranges from 81,000 to 138,000 according to published reports. Snakebite envenoming results in up to 400,000 amputations and many other lasting disabilities. Several snakebites are generally unreported due to victims looking after treatment from non-medical sources or lack access to healthcare. Many cases of snakebite are believed to go unreported.<sup>[1]</sup>

A nationally representative study called the Million Death Study reported 45,900 snakebite deaths annually in the country. Approximately 90% of snakebites in India are attributed to the 'big four' snake species - Indian cobra, Common krait, Russell's viper, and saw-scaled viper.<sup>[1]</sup>

The initial symptoms of pain along with the swelling at the sites of bite typically manifest within minutes after being bitten. The swelling may affect the entire limb. Blistering or localized necrosis may be evident. Patients severely poisoned by venom may develop DIC (Disseminated Intravascular Coagulation), which results in uncontrolled bleeding that too from various parts of the body.<sup>[2]</sup> Blood could leak continuously that too from the marks of the bite, or severe bleeding may be obvious as melena, hematemesis, hemoptysis, or bleeding into different body areas like fascial compartments, muscles, serous cavities, and the subarachnoid space. Prompt identification and appropriate actions could decrease the AKI occurrence.<sup>[3]</sup>

AKI (Acute kidney injury) is a recognized severe systemic consequence of snake venom poisoning that often occurs as a result of snake bites. AKI presents with symptoms such as fatigue, nausea, anorexia, oliguria, vomiting, cephalalgia, and anuria. Monitoring Blood pressure, fluid balance, blood urea nitrogen, serum electrolytes, and serum creatinine is beneficial for managing AKI caused by the venom of snakes.<sup>[4]</sup> Snake antivenoms are efficacious in preventing or reversing the majority of adverse effects caused by snakebite envenoming.

### **Aim & Objectives**

#### **Aim**

- Prevalence of AKI in children with snake bite envenomation in a tertiary care hospital.

#### **Objectives**

- To study the predictors of AKI in children with snake bite envenomation.
- To determine the outcome of children with snake bite envenomation.

## **MATERIALS & METHOD**

Cross-sectional research has been performed among the 100 children admitted with snake bite envenomation in the PICU of Niloufer Hospital from July 2020 to June 2022.

### **Inclusion Criteria**

- Age: 1 year – 12 years
- Parents willing to give informed consent

### **Exclusion Criteria**

- Age <1 month and >12 years
- Children with pre-existing renal disease
- Children on nephrotoxic drugs
- Children with underlying medical conditions – neurological, hematological, etc.
- Children who died within 12 hours of admission
- Children with parents not willing to give informed consent

After obtaining the informed consent, a detailed history was taken, a systemic examination was conducted and it was recorded in a pre-designed structured proforma. The following blood investigations were done:

- 20 min WBCT every 6th hourly
- CBP, Blood Sugar, PT, APTT
- Serum electrolytes, Creatinine, Blood urea – daily
- CUE, LFT, ECG, X-ray
- USG abdomen.

AKI was diagnosed according to KDIGO guidelines using serum creatinine levels and urine output, and treated accordingly.

AKI is characterized by any of the following:

- Increase in SCr by X0.3 mg/dl (X26.5  $\mu$ mol/l) in 48 hrs; or
- Increase in SCr to X1.5 times baseline, which is known or presumed to have occurred within the prior 7 days; or

Urine volume 0.5 ml/kg/h for 6 hrs.

## RESULTS

The results of the study are as follows:

The demographic characteristics features are shown in Table 1. The majority of them belonged to the age group of 1-10 years. 56% of the study population was males and 44% were females. The majority of them (72%) belonged to urban areas. Only 28% belonged to rural areas.

**Table 1 shows the demographic characteristic features**

Parameter	Frequency	Percentage
<b>Age group</b>		
Upto 12 months	3	3
1-5 yrs	39	39
6-10 yrs	38	38
11-12 yrs	20	20
<b>Gender</b>		
Female	44	44
Male	56	56
<b>Area of residence</b>		
Rural	28	28
Urban	72	72

**Table 2 shows the type of snake, characteristics of the bite, and clinical features**

Parameter	Frequency	Percentage
<b>Type of snake</b>		
Cobra	38	38
Krait	21	21
Russels Viper	25	25
Unknown	16	16

<b>Bitesite</b>		
Leg	40	40
Foot	38	38
Toe	10	10
Calf	8	8
Shin	4	4
<b>Clinical Features</b>		
Vomiting	42	42
Pain abdomen	38	38
Dark colored urine	8	8
Local swelling	12	12
<b>CUE findings</b>		
Red colored urine	8	8
Straw colored	92	92

The details of the type of snake, site of the snake bite, and clinical features are mentioned in **Table 2**. The majority (38%) of the snake bites were of King Cobra, followed by Russell’s viper (25%) and Krait (21%) . The majority of the bites were on the legs (40%), and feet (38%). Vomiting (42%) was the commonest clinical feature followed by pain abdomen (38%) and local swelling (12%).8% of the patients had high-colored urine with RBC>5/HPF.

There was no history of walking after a snake bite in the study population.

The majority of the admissions (88%) were within the first 24 hours of the snake bite and only 17% received ASV at the Primary health center from where they were referred to the tertiary care center for treatment. All 17% of the patients received ASV within the first 24 hours of snake bite. Renal involvement was seen in 18%, neurological system in 16%, and hematological manifestation in 14%.(**Table 3**)

**Table 3 shows the characteristic features related to admission and ASV**

Parameter	Frequency	Percentage
<b>Quack treatment before admission</b>		
Tourniquet	6	6
Suction	5	5
None	89	89
<b>Time taken from bite to admission</b>		
Within 6 hours	16	16
6-12 hours	31	31
13-24 hours	41	41
25-36 hours	7	7
37-48 hours	5	5
<b>ASV vials given elsewhere before admission</b>		
No	83	83

Yes	17	17
<b>The time at which ASV was given</b>		
Within 2 hours	2	11.76
2-6 hours	4	23.53
6-12 hours	7	41.17
13-24 hours	4	23.52
<b>Systems involved</b>		
Hematological	14	14
Neurological	16	16
Renal	18	18

The prevalence of AKI was 18%, out of which 38.88% were pre-renal and 61.11% were intrinsic renal as shown in Table 4.

**Table 4 shows the prevalence of AKI**

Parameter	Frequency	Percentage
<b>Acute Kidney Injury</b>		
Present	18	18
Absent	82	82
<b>Type of AKI</b>		
Pre renal	7	38.88
Intrinsic Renal	11	61.11

Patients belonging to rural areas, with more time taken for admission, were found to be the significant AKI predictors. Serum creatinine as well as blood urea levels at admission time were also significant AKI predictors. The patients who developed AKI had higher blood urea and serum creatinine values. Higher serum potassium levels and the requirement of inotropes were also significantly higher in patients with AKI.(Table 5,6,9).

**Table 5 shows the renal parameters in patients with AKI:**

Parameter	At admission	24 hrs after admission	48 hrs after admission	72 hrs after admission
Blood Urea	49.6±6.9	59.68±8.98	78.98±10.59	124.56±12.69
Serum Creatinine	1.1±0.29	1.4±0.57	1.8±1.0	2.4±0.98

**Table 6 shows the predictors of AKI**

Predictors	AKI present(n=18)	AKI absent (n=82)	P value
Rural residence	14	4	<0.0000001
Time taken from bite to admission in hours	12.4±1.2	6.4±4.5	<0.0000001

Requirement of ionotropes	8	2	0.001
Serum potassium levels	7.45±1.8	4.1±1.6	<0.0000001
Blood urea levels at admission	49.6±6.9	46±7.9	<0.0000001
Serum creatinine levels at admission	1.1±0.29	0.75±0.26	0.00001

Apart from ASV, these children were managed with supportive treatment with intravenous fluids (100%), with 89 % received antibiotics, 6% were given whole blood transfusion and 2% were given FFP and platelets respectively.( Table7)

**Table 7 shows the supportive treatment**

Supportive treatment	Frequency	Percentage
IVF	100	100
Antibiotics	89	89
FFP	2	2
Platelets	2	2
Whole blood	6	6

Mortality was present in 3 children with AKI(16.66%) of the overall study population ( Table 8). These deaths were due to Multiple Organs Dysfunction Syndrome (MODS).

**Table 8 shows the outcome of AKI**

Outcome	Frequency	Percentage
Death	3	16.66
Discharged	15	83.33
Total	18	100

**Table 9 shows the predictors of AKI**

Predictors	Pre renal AKI (n=7)	Intrinsic renal AKI (n=11)	P value
Time taken from bite to admission in hours	7.25±1.9	14.65±4.5	0.001
Requirement of ionotropes	3	9	0.04
Mechanical ventilation	0	7	0.03
Dialysis	0	5	0.01
Urine output(<0.5ml/kg/hr)	2	9	0.02

Serum potassium levels	7.45±1.8	8.7±0.6	0.04
Blood urea levels at admission	41.5±4.8	61.56±8.9	0.00005
Serum creatinine levels at admission	0.98±1.1	2.9±1.2	0.003

Dialysis was done in 5 patients with intrinsic renal AKI, out of which 3 patients died and 2 survived.

**DISCUSSION**

The present cross-sectional study was conducted among the 100 children admitted with snake bite evenomation in the PICU of Nilofer Hospital, for a duration of 24 months from July 2020 to June 2022. The objectives of the study were to study the prevalence of AKI, its predictors, and the outcome among the study population.

The majority of the patients belonged to the age group of 1-10 yrs (77%). 56% of the study population were males and 44% were females. Similar to a study done by **Paul and Dasguptal**<sup>[5]</sup>, where two-thirds of the population were males. Similar results have been observed in a study done by **Pulimaddi et al**<sup>[6]</sup> where as in a research done by **Vikrant S et al**<sup>[7]</sup>., the distribution was 42% males and 58% females showing female preponderance.

The common bitesite was the lower limb and similar findings were observed by **Pulimaddi et al**<sup>[6]</sup> and **Vikrant S et al**<sup>[7]</sup>. The mean time of the bite and ASV administration was around 85.36 min with a standard deviation of 4.43 min according to **Paul and Dasguptal**<sup>[5]</sup>. In the present study, ASV was administered within 24 hours of snake bite.

In the present study, 88% were admitted to the hospital within the first 24 hours. Similar findings were observed by **Pulimaddi et al**<sup>[6]</sup>., where 86% of the admissions were within the first 24 hours of snake bite.

In the current research, Vomitings (42%) was the commonest clinical feature followed by pain abdomen (38%) and local swelling (12%). In contrary to a study done by **Paul and Dasguptal**<sup>[5]</sup>, where swelling was the most common feature (57.30%), followed by brown urine (52.04%) and bleeding manifestations(47.95%).

In the current research, renal involvement has been observed in 18%, neurological system in 16%, and hematological manifestation in 14%. In a study done by **Paul and Dasguptal**<sup>[5]</sup>, neurological involvement was seen in 15.78%. In research done by **Vikrant S et al**<sup>[7]</sup>., neurotoxicity was seen among 5.7%, hematological involvement was seen in 88.6%.

The prevalence of AKI was 18% in the present study. **Paul and Dasguptal**<sup>[5]</sup>, reported a prevalence of 43.27%, and **Pulimaddi et al**<sup>[6]</sup>., observed 100 cases of AKI.

In the present study, patients belonging to rural areas (P<0.000001), with longer time taken for admission (P<0.000001), were significant predictors of AKI. Blood urea (P<0.000001), and serum creatinine (P<0.0001) levels at the time of admission were also significant AKI predictors. The patients who developed AKI had higher blood urea and serum creatinine values. Higher serum potassium levels (P<0.000001), and requirement of ionotropes (P=0.001), were also significantly greater in patients who are experiencing the AKI.

In a study done by **Islam K et al**<sup>[8]</sup>., rural areas of residence were associated with the development of AKI with OR=5.1(3.8-6.4). Other predictors that were mentioned were serum potassium levels with OR=9.9(8.2-11.6), and use of ionotropes with OR=5.5(4.7-6.3).

In the present study, mortality was present in 16.66% of patients who were suffering from AKI and 83.33% of children survived similar to research done by **Vikrant S et al**<sup>[7]</sup>, where in 90.9% survived.

## **CONCLUSION**

Area of residence, time taken for admission, serum potassium, blood urea, and serum creatinine levels at admission were strong predictors of AKI. Our findings also showed that early admission, timely ASV administration and adequate supportive care are associated with good outcome. The limitations of the study were small sample size, non-identification of snake in few cases and inability to perform renal biopsy.

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**Conflicts of interest: None.**

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