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Incidence, Clinical Profile and Outcome of Acute Kidney Injury Among Venomous Snake Bite Victims Prospective Observational Study

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ABSTRACT

Acute Kidney Injury (AKI) is a major complication of venomous snake envenomation, contributing to significant morbidity and mortality, especially in tropical regions. This study evaluates the incidence, clinical profile and outcomes of AKI in snakebite victims at Government Villupuram Medical College, Tamil Nadu. This prospective observational study included 105 patients with venomous snake envenomation and AKI. Clinical data, including snake type, bite-to-needle time, renal function and clinical manifestations, were recorded. Outcomes were based on the need for renal replacement therapy (RRT) and recovery. The study included 66 males (63%) and 39 females (37%). Russell's Viper was the most common envenoming snake (29.5%). AKI was associated with coagulopathy, hematuria and oliguria. 36.19% required RRT and 83.8% recovered. The mortality rate was 5.71%. AKI is a frequent and severe complication of venomous snake bites. Early intervention with anti-snake venom and renal support can improve patient outcomes and reduce mortality.

INTRODUCTION

Snakebite is a cause of major healthcare concern globally and is a preventable health hazard with the highest impact in countries like India. Snake envenomation causes significant mortality and morbidity in tropical as well as subtropical countries of the world. 64% of the total population of India resides in rural area and snake bites are common in rural areas. This puts a large proportion of the Indian population at risk for sustaining snake envenomation. With an average estimation of Snake bite related death climbing to an incredible 58,000 per year as per assessment from previous reports India can be called as the snakebite capital of the world[1]. Distributed throughout the country with significant spatial dispersions this menace is undoubtedly one of the biggest neglected tropical diseases. The odds of an Indian dying from a snake bite before 70 years translates to 1 in 250, which is incredibly frightening statistics[2]. The data analyzed from the first 2 decades of this century from 2000-2019 reveals a staggering figure of 1.2 million deaths in the country due to snake envenomation[1]. The total number of cases sustaining snake bites are much higher and is grossly under reported. Almost half of the global burden of snake bite related death are from India. Along with mortality, snake bite causes significant morbidity too. It can cause necrotising fascitis, cellulitis, neuro paralysis, de-efferentiation, compartment syndromes and acute kidney injury, many of which may cause lasting impacts on the patient's health. The state of Tamil Nadu witnesses a large number of snake bites each year. The Government Villupuram Medical College serves as a referral centre and a centre of excellence in managing snake bite cases in an around 4 districts of Tamil Nadu including Villupuram, Cuddalore, Thiruvannamalai and Kallakurichi and parts of Pondicherry. It covers >8 lakh households and a population of >4 million of which majority are farmers or farm 15 related workers who are at a high likelihood of sustaining snake bite during their indulgence in activities of daily living and otherwise. Snake bite cases are often under reported because many people seek alternate medicinal care including native medicine and traditional healers of which may include several non-venomous bites. However, many venomous snake bites seek medical care at primary and secondary care centers of which many gets referred to our centre in view of impending complications and some may directly come to our centre as a primary health care facility. Acute kidney injury occurs in approximately 31% of patients with snake envenomation and it is a serious complication[3]. It can cause significant hospital mortality in around 40% of those affected by AKI 4 and also can cause lasting effects on the patient's health status by progressing into CKD. This study done at Govt. Villupuram Medical College and Hospital aims to understand the incidence, clinical profile and outcome of acute kidney injury among patients with snake envenomation.

MATERIALS AND METHODS

Study Setting: This study was conducted in the Department of General Medicine at Government Villupuram Medical College, Villupuram.

Study Design: This was a single-center, prospective observational study.

Study Period: The study was conducted over a period of two years.

Sample Size: A total of 100 patients who developed acute kidney injury (AKI) following a snake bite and met the inclusion and exclusion criteria were included in the study.

Selection of Study Subjects: Consecutive cases of snake bite leading to AKI, fulfilling the inclusion and exclusion criteria, were enrolled in the study.

Inclusion Criteria:

- A definitive history of snake bite with a clinical picture consistent with venomous envenomation.
- **Age Group:** 18-80 years.
- Presence of acute kidney injury (AKI), defined as an abrupt (within 48 hours) absolute increase in serum creatinine concentration of >0.3 mg/dL from baseline (measured at admission within 48 hours) or a 50% increase in serum creatinine concentration above baseline within 7 days, or oliguria of <0.5mL/kg per hour for more than six hours.

Exclusion Criteria:

- Patients with pre-existing renal disease, ultrasonogram-proven chronic kidney disease, or already diagnosed chronic kidney disease.
- Exposure to nephrotoxic drugs or toxins.
- Acute kidney injury due to other etiologies.

Study Protocol: Eligible patients were screened on admission based on the inclusion and exclusion criteria. AKI in snake bite cases was identified through clinical features and biochemical parameters such as raised blood urea and serum creatinine from baseline. Diagnosis was corroborated using ultrasonographic findings, assessing kidney size, internal echoes and corticomedullary differentiation. Patients meeting the inclusion criteria were recruited into the study after obtaining informed consent. All patients received anti-snake venom (ASV) as per the National Snakebite Protocol and were monitored for ASV requirements in line with WHO SEARO Guidelines for anti-hemostatic envenomation.

Clinical Parameters Monitored: The following clinical parameters were recorded every 12 hours: Age and sex, Comorbidities, Type of snake, Bite-to-injection time, Quantity of intravenous fluids administered, Local reaction (cellulitis progression, regional lymphadenopathy), Bleeding manifestations, Systemic symptoms, Number of ASV vials transfused and any associated reactions, Urine output, Blood pressure and pulse rate, Need for fresh frozen plasma (FFP) and platelets. Patients were categorized into four grades based on the traditional snakebite grading system. Severity scoring was performed using the Snakebite Severity Score and correlations were made between AKI stage and clinical/biochemical parameters.

- Biochemical and Hematological Investigations.
- Blood urea and serum creatinine levels.
- Complete urine examination by microscopy.

Hematology Parameters: Complete blood count (CBC), platelet count, leukocyte count, differential count.

Coagulation Parameters: 20-minute whole blood clotting time (WBCT), prothrombin time (PT) and international normalized ratio (INR). Ultrasonography (USG) of the abdomen using standard procedures. Renal function was monitored daily. Prognosis was assessed based on:

- Duration and need for hemodialysis (HD).
- Improvement in renal parameters and urine output.
- Morbidity and mortality.
- Progression to chronic kidney disease.
- All collected data were subjected to statistical analysis upon study completion.

Statistical Analysis: Data were entered into a Microsoft Excel datasheet and analyzed using statistical software. Statistical scrutiny was performed using both uni variate and multi variate analysis.

Ethical Considerations: The study was approved by the Institutional Ethical Committee.

RESULTS AND DISCUSSIONS

This study was a single centre, prospective observational study. A total of 105 participants took part in the study. The study population comprised of 66 males (63%) and 39 (37%) females.

Table 1: Showing the Gender Wise Distribution of Cases

Gender	Number of cases	Percentage
Male	66	63%
Female	39	37%

All the consecutive cases of snake bite which developed AKI following snake bite were included in this study. A striking highlight was that all the cases who developed AKI following snake bite had coagulopathy as evidenced by increased whole blood clotting time.

Table 2: Showing Distribution of Cases with Respect to Age Group

Gender	18-40 years	40-60 years	>60years	Total
Male	40	18	8	66
Female	24	13	2	39
Total	64	31	10	105

Table 3: Depicting the Relative Proportion of Snakes

Snake	No. of cases	Percentage
RussellsViper	31	29.5%
Sawscaled viper	5	4.76%
Unidentified	69	65.7%

Snakes responsible for envenomation was largely unidentified in almost 65.7% of cases (n=69). Rusells viper caused envenomation in 29.5% cases (n=31), whereas saw scaled viper envenomation resulted in AKI in 4.76% (n=5).

Table 4: Data Representing Bite to Needle Time and Incidence of AKI

Bite to Needle Time	STAGE1	STAGE2	STAGE3	Total
<6hours	71	13	2	86
6-12 hours	1	7	4	12
>12hours	0	3	4	7

Table 5:Clinicalmanifestations of Snake Bite in Study Population

Clinical manifestations	No of Cases	Percentage
Cellulitis	89	84.76
Hematuria	55	52.38
Coagulopathy	105	100
Thrombocytopenia	47	44.76
Neurotoxicity	44	41.9
Oliguria	55	52.38
Lymphadenopathy	64	60.95

Table 6:Depicting Mean Daily Serum Creatinine Daily

Day	Mean creatinine	Standard deviation
1	1.47	0.944
2	2.67	1.125
3	3.16	1.326
4	3.173	1.713
Peak creatinine	4.26	2.49

Table7 : Outcomes of Patients in the Study Population

Outcome	Number of cases	Percentage
Recovered	88	83.8%
Not recovered	11	10.47%
Dead	6	5.71%

Out of the 105 cases of AKI recruited for the study, 53.3% patients (n=56) was managed with conservative treatment alone. 49 patients were offered renal replacement therapy, out of which 5 patients expired, 10.47% (n=11) patients were on maintenance hematolysis, 36% (n=38) patients were given temporary RRT support in the form of hemodialysis and recovered completely from AKI.

Table 8: Management Strategies in Patients with Ak

Management of AKI	No of Patients	Percentage
Temporary RRT	38	36.19%
MaintenanceHemodialysis	11	10.47%
No RRT	56	53.3%

Snakebite is a major public health concern in India, particularly in rural regions, where the majority of the population is at risk due to agricultural activities. The study highlights the significant incidence and clinical profile of acute kidney injury (AKI) among snakebite victims, underscoring its serious complications, including morbidity and mortality. In this study, 63% of the participants were male, which aligns with previous studies indicating a higher incidence of snakebites

among men due to their involvement in outdoor activities, especially farming and agriculture. This is consistent with the findings from Suraweera *et al.*, who also reported a higher incidence of snakebites in rural male populations[1]. The age distribution in our study revealed that the majority of the cases occurred in the younger age groups (18-40 years), which is consistent with earlier reports showing that snakebites primarily affect working-age adults who are involved in agricultural work[2]. The most commonly identified snake responsible for envenomation in this study was the Russell's viper (29.5%), followed by the Saw-scaled viper (4.76%). These findings are in agreement with previous studies in India, where the Russell's viper has been identified as the most common culprit in snakebite cases, known for its venomous properties that can lead to severe complications like coagulopathy and AKI[3]. In this study, 65.7% of cases involved unidentified snakes, which further points to the challenges in snakebite management, especially in regions where snake identification is difficult. A significant finding of this study was the presence of coagulopathy in all patients with AKI. This corroborates earlier research by Dharod *et al.*, who reported coagulopathy as one of the most common manifestations of snake envenomation, with prolonged clotting times leading to severe complications[3]. Additionally, hematuria (52.38%), thrombocytopenia (44.76%) and neurotoxicity (41.9%) were also prevalent, suggesting that multi-organ involvement is a hallmark of severe snake envenomation. These findings are consistent with the global understanding that snake venom can have systemic effects, affecting the kidneys, coagulation pathways and nervous system[4]. The management of AKI in snakebite victims in our study varied. About 53.3% of patients were managed conservatively, while 36% received temporary renal replacement therapy (RRT) and 10.47% required maintenance hemodialysis. The outcome of treatment was promising, with 83.8% of patients recovering fully and only 5.71% of patients succumbing to the effects of AKI. These findings suggest that early identification and treatment, including adequate fluid resuscitation and the use of anti-snake venom (ASV), are crucial for improving outcomes in snakebite victims[5]. The need for renal replacement therapy (RRT) in nearly half of the patients highlights the severity of AKI in snakebite envenomation and the role of RRT in saving lives is well documented in studies on snake envenomation[6]. Furthermore, the study revealed that a shorter "bite to needle time" (<6 hours) correlated with less severe stages of AKI (Stage 1). This reinforces the importance of early administration of ASV, as prompt treatment can mitigate the extent of kidney damage and reduce the need for more intensive interventions like hemodialysis[7]. The mortality rate observed in this study (5.71%) is in line with other studies conducted in India, where the fatality rate among snakebite victims with AKI has been reported to range from 5-20%[8]. This study also emphasizes the long-term risks associated with snake envenomation, as some cases progress to chronic kidney disease (CKD), highlighting the need for long-term monitoring of kidney function in snakebite survivors. In conclusion, this study provides valuable insights into the incidence, clinical profile, and outcome of AKI in snakebite victims, reinforcing the need for early diagnosis and intervention. Early administration of ASV, fluid resuscitation and timely renal replacement therapy are essential for improving survival and reducing the incidence of long-term kidney damage in snakebite victims.

CONCLUSIONS

This study highlights the significant incidence of acute kidney injury (AKI) among snakebite victims, with a notable correlation between coagulopathy and renal complications. The majority of snakebites were attributed to unidentified snakes, with Russell's viper being the second most common envenomator. The severity of AKI was associated with the time to administration of anti-snake venom (ASV), with earlier interventions resulting in better outcomes. Renal replacement therapy, particularly temporary hemodialysis, played a critical role in managing patients with severe AKI, although a substantial proportion of patients recovered with conservative management. Despite the high recovery rate, the mortality rate remains concerning, underscoring the need for timely medical intervention and effective management strategies for snakebite-related AKI. Further research on the long-term outcomes and optimal treatment protocols is essential to improve patient prognosis.

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