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Exploring The Impact of Bite-to-Needle Time on Snakebite Complications: Insights from a Study at Tertiary Care Hospital

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ABSTRACT

Background: Snakebite envenoming is an acute life-threatening time-limiting medical emergency necessitating prompt intervention. Timely treatment is often hindered by delayed hospital arrival, delayed treatment, and initial reliance on traditional healers, exacerbating adverse outcomes. This study was conducted to assess whether the bite-to-needle time impacts on complications in snakebite patients, reasons behind the delay in Anti Snake Venom administration, clinico-epidemiological profiles and first aid awareness in victims.
Methods: A hybrid study enrolled 124 snakebite patients admitted between January 2022 and April 2023. Statistical analysis using Chi-square and Pearson's correlation tests evaluated the impact of BNT on complications.
Results: The study revealed higher snakebite incidence in males 53.22%, mostly 74% in 21 to 50 years of age group, farmers 78.22%, from rural areas 77%. A significant positive correlation between BNT and complications is revealed. Notably, 100% of patients with BNT exceeding 8 hours, 96.66% with BNT between 4–8 hours, and 65.58% with BNT within 0–4 hours developed complications. Delayed ASV administration was attributed to various factors, including transportation issues (28.2%), delay after primary health center (PHC) (13.7%), unavailability of personnel for help at incidence place (11.3%), distant hospitals (10.5%), patient ignorance (7.3%), and no sense of damage (6.5%).
Conclusion: This study underscores the critical importance of prompt ASV administration in preventing complications. The direct correlation between BNT and complications highlights the need for enhanced public awareness of snakebite ASV, first aid and timely medical intervention to mitigate morbidity, mortality and to improve the quality of life.

Keyword: Bite-to-needle time, Snakebite Envenoming, Complications, First Aid, ASV, Adverse Events.

INTRODUCTION:

The World Health Organization (WHO) estimates that 5 million snakebites occur worldwide each year, resulting in up to 2.7 million envenomed. Published reports indicate that between 81,000 and 138,000 people die each year worldwide, snake bites cause up to 400,000 amputations and other permanent disabilities.[1,2,3,4] It is a preventable public health hazard often faced by rural populations in tropical and subtropical countries with heavy rainfall and humid climate, mainly those involved in subsistence farming activities.[5] It's an important cause of morbidity and mortality, especially in sub-Saharan Africa, south to Southeast Asia, Papua New Guinea, and the Latin Republic.[6,7,8] At least 46,000 of deaths occur in India alone considering the worldwide snakebites deaths, the published reports says, India had 1.2 million snakebite deaths from 2000 to 2019 (an average of 58,000 per year), almost half of the victims are aged 30-69 and more than a quarter are children under 15 years of age, the largest number of deaths reported in India are from Bengal, Uttar Pradesh (up), Tamil Nadu, and Bihar.[6,9]

Approximately 3,500 snake species exist globally, with less than 350 being venomous. In India, venomous snakes pose a significant threat, particularly the "Big Four" 1. *Common krait (Bungarus caeruleus)* 2. *Common cobra (Naja naja)* 3. *Saw-scaled viper (Echis carinatus)* 4. *Russell's viper (Daboia russelii)*. Snakebites envenoming is an acute life-threatening time limiting medical emergency, and these species are responsible for most snakebite envenoming related morbidity and mortality in India.[5,10] Anti-snake venom (ASV) is the first line treatment and should be given as soon as it is indicated, it neutralizes circulating venom only and no amount of ASV neutralizes once the venom is attached or adsorbed to the target organ. ASV does not eliminate venom from the body, does not reverse anything or nor it make the patient better, it just neutralizes the snake venom.[5,11]

In previously conducted studies, [12,13,14,15,16] it is observed that many snakebite victims fail to reach hospitals in time or seek medical care after a considerable delay, resulting in high morbidity and mortality. The present study aimed to assess the relationship between timing of ASV administration and complications in snakebite patients, factors reasonable for delay in receiving ASV, clinico-epidemiological profile, clinical management, first aid awareness and clinical outcomes of snake bite patients. By exploring these aspects, the study seeks to provide valuable insights to reduce morbidity and mortality, ultimately improving the quality of life for snakebite victims.

MATERIAL AND METHODS:

A hybrid observational study, integrating prospective and retrospective design, was conducted at the Department of Medicine, Government Medical College and Hospital, Aurangabad. Following approval from the Institutional Ethics Committee, 124 snakebite patients admitted between January 2022 and April 2023 were included in the study. Patients were eligible for enrollment if they met the inclusion criteria, which included being willing to participate in the study (with consent forms applicable for prospective patients), being over 12 years of age, having a confirmed snakebite, and having received ASV treatment. Pregnant and breastfeeding females were excluded. Data collection utilized a Case Report Form (CRF) that captured demographic information, including gender, age, geographical location, and occupation, as well as first aid, identified bitten snake, bite-to-needle time (BNT), type of complications with bitten snake, victims had complications and no-complications with respective BNT, ASV administration, adverse events (AE), reasons for delay in receiving ASV, and clinical outcomes. Case files of the patients were reviewed and discussed with respective ward treating physicians, and the study required data were recorded in CRF. In some patients, missing information, such as reasons for delay in receiving ASV and first aid, was gathered through telephonic *contact* with the patients or their relatives. The CRF data were transferred to MS Excel for data analysis and appropriate statistical tests, including Chi-square and Pearson correlation were used.

RESULTS:

This study analyzed 124 snakebite victims, revealed, a male predominance 53.22% compared to females 46.78%. The most affected victims were in the age groups 21-50 years 74%, from rural areas 77%, with occupation as a farming 78.22%. And the large number of victims, 42.60% had not received any first aid (Table 1).

Table 1: Snakebite patients' demographic, epidemiological, and first aid profile.

Parameter	Frequency (100%, n=124)
Gender	
Male	53.22%
Female	46.78%
Age	
<21 Years	13%
21-50 Years	74%
>50 Years	13%
Geographical	
Rural	77%
Urban	23%
Occupation	
Farmers	78.22%
Servants	12.91%
Students	8.87%

First Aid	
No first aid received	42.60%
First aid at PHC	34%
Tourniquet	23.40%

Among the study population, most of the victims 62.90% had BNT 0-4 hrs., and least of those 0.80% had BNT over 24 hrs. Of these victims vasculotoxic snake bites were most common 46.77%, followed by mixed type 42.74% and neuroparalytic bites 10.48%. No myotoxic case was observed (Table 2).

Table 2: Cases distribution based on bitten snake and bite-to-needle time.

Bitten Snake	0 to 4 (Hrs)	4 to 8 (Hrs)	8 to 12 (Hrs)	12 to 24 (Hrs)	>24 (Hrs)
Viper	36	15	1	5	1
Russell's viper	28	9	2	3	0
Cobra	8	4	2	0	0
Krait	6	2	1	1	0
Grand Total	62.90%, n=78	24.19%, n=30	4.84%, n=6	7.25%, n=9	0.80%, n=1

*Categorywise: Vasculotoxic (46.77%, n= 58), mixed type (42.74%, n=53), neuroparalytic (10.48%, n=13) and myotoxic (0%, n=0).

Amongst the study population, with proportionate to BNT from 0-4 hrs. to more than 24 hrs., the frequency of complications were increased, cellulitis (14.10% to 100%), anemia (12.82% to 100%), uremia (10.26% to 22.22%), hypotension (1.28% to 22.22%), hematuria (3.85% to 11.11%), Lower Respiratory Tract Infection (LRTI) (6.67% to 16.67%), neutrophilia (50% to 100% and then to 55.56%), leukocytosis (47.44% to 83.33% and then to 66.67%), respiratory failure (7.69% to 50% and then to 11.11%), thrombocytopenia (12.82% to 50% and then to 33.33%), acute kidney injury (AKI) (1.28% to 10%), and progressive swelling (15.38% to 33.33%) (Table 3).

Table 3: Cases distribution based on complications with bitten snake and bite-to-needle time.

Complication in cases (%, n) and Bitten snakes (n)	0-4 hrs.	4-8 hrs.	8-12 hrs.	12-24 hrs.	>24 hrs.
Neutrophilia	50%, n=39	56.67%, n=17	100%, n=6	55.55%, n=5	-
Bitten snakes	*Russell's viper*-22, *viper*-12, *Cobra*-5	*Viper*-9, *Russell's viper*-4, *Cobra*-3, *Krait*-1	*Russell*'s viper-2, *Cobra*-2, *Viper*-1, *Krait*-1	*Viper*-2, *Russell's viper*-2, *Krait*-1	-
Leukocytosis	47.44%, n=37	53.33%, n=16	83.33%, n=5	66.66%, n=6	-
Bitten snakes	*Russell's viper*-22, *Viper*-11, *Cobra*-4	*Viper*-9, *Russell's viper*-4, *Cobra*-3	*Russell's viper*-2, *Cobra*-2, *Krait*-1	*Viper*-3, *Russell's viper*-2, *Krait*-1	-
Thrombocytopenia	12.82%, n=10	36.67%, n=11	50%, n=3	33.33%, n=3	-
Bitten snakes	*Russell's viper*-4, *Viper*-3, *Cobra*-3	*Viper*-6, *Russell's viper*-3, *Cobra*-2	*Russell's viper*-2, *Cobra*-1	*Russell's viper*-2, *Viper*-1	-
Progressive swelling	15.38%, n=12	33.33%, n=10	-	-	-
Bitten snakes	*Viper*-6, *Russell's viper*-5, *Cobra*-1	*Viper*-8, *Russell's viper*-2	-	-	-
Cellulitis	14.10%, n=11	16.67%, n=5	16.67%, n=1	44.44%, n=4	100%, n=1
Bitten snakes	*Russell's viper*-6, *Viper*-4, *Cobra*-1	*Viper*-3, *Russell's viper*-2	*Russell's viper*-1	*Russell's viper*-2, *Viper*-2	*Viper*-1

Anemia	12.82%, n=10	30%, n=9	50%, n=3	11.11%, n=1	100%, n=1
Bitten snakes	*Russell's viper*-6, *Viper*-2, *Cobra*-2	*Viper*-7, *Cobra*-1, *Krait*-1	*Cobra*-2, *Russell's viper*-1	*Viper*-1	*Viper*-1
RF	7.69%, n=6	10%, n=3	50%, n=3	11.11%, n=1	-
Bitten snakes	*Cobra*-4, *Krait*-2	*Cobra*-2, *Russell's viper*-1	*Cobra*-2, *Russell's viper*-1	*Krait*-1	-
Uremia	10.26%, n=8	6.67%, n=2	-	22.22%, n=2	-
Bitten snake	*Russell's viper*-4, *Cobra*-2, *Viper*-1, *Krait*-1	*Russell's viper*-1, *Viper*-1	-	*Viper*-1, *Krait*-1	-
Hypotension	1.28%, n=1	13.33%, n=4	-	22.22%, n=2	-
Bitten snakes	*Russell's viper*-1	*Viper*-2, *Russell's viper*-1, krait-1	-	*Viper*-2	-
Hematuria	3.85%, n=3	6.67%, n=2	-	11.11%, n=1	-
Bitten snakes	*Russell's viper*-1, *Viper*-1, *Cobra*-1	*Russell's* viper-1, *Cobra*-1	-	*Russell's viper*-1	-
DIC	-	6.67%, n=2	-	11.11%, n=1	-
Bitten snakes	-	*Russell's viper*-1, *Viper*-1	-	*Viper*-1	-
AKI	1.28%, n=1	10%, n=3	-	-	-
Bitten snakes	*Cobra*-1	*Russell's* viper-2, *Viper*-1	-	-	-
LRTI	-	6.67%, n=2	16.67%, n=1	-	-
Bitten snakes	-	*Cobra*-1, *Russell's,* viper-1	*Cobra*-1	-	-
HIE	-	3.33%, n=1	-	-	-
Bitten snakes	-	*Cobra*-1	-	-	-
Septic shock	-	-	16.67%, n=1	-	-
Bitten snakes	-	-	*Cobra*-1	-	-
Septicaemia	-	3.33%, n=1	-	-	-
Bitten snakes	-	*Viper*-1	-	-	-
ARDS	-	33.33%, n=1	-	-	-
Bitten snakes	-	*Russell's viper*-1	-	-	-

In this study, the relationship between BNT and complications was statistically analyzed using "Chi-square and Pearson's coefficient tests". Patients receiving ASV within 0-4 hours had a complication rate of 65.58% (n=51), whereas those receiving ASV within 4-8 hours, 8-12 hours, and beyond 12 hours had complication rates of 96.66% (n=29), 100% (n=6), and 100% (n=10), respectively. Statistical analysis using the Chi-Square test revealed a significant association between BNT and complications ($p=0.0015$, 95% CI, $p<0.05$). Furthermore, Pearson Correlation analysis showed a strong positive correlation between BNT and complications ($r=0.665$, significant between 0 to +1). These findings indicate a significant association between delayed ASV administration and increased risk of complications in snakebite patients. The increased BNT indicates the increased duration of venom stay in the body of victims and thus, the complications occurred. Therefore, this finding highlights the importance of timely administration of ASV in reducing the complications (Table 4).

Table 4: Cases distribution based on complications and no-complications with bite-to-needle time.

BNT (Hrs.)	Total complicated cases (n)	Total complicated cases (%)	Total uncomplicated cases (n)	Total uncomplicated cases (%)	Total cases within respective BNT (n)

0-4	51	65.38%	27	34.62%	78
4-8	29	96.67%	1	3.33%	30
8-12	6	100%	0	0%	6
12-24	9	100%	0	0%	9
>24	1	100%	0	0%	1

*P value=0.0015, Confidence Interval (CI)=95%, p<0.05).

In the present study, it is noted that most patients (41.94%, n=52) required 11-20 vials of ASV. The ASV adverse events were observed, with the most common being mild hypotension (8.06%, n=10), fever (5.65%, n=7), hypertension (6.45%, n=8), and rigors (4.3%, n=5). Moderate adverse events included tachycardia (4.83%, n=6), tachypnea (3.23%, n=4), and bradycardia (0.81%, n=1). Other less frequent adverse events were itching, urticaria, and abdominal pain, each of which occurred in 0.81% (n=1) of patients. Transportation issues (28.2%, n=35) and delays after PHC (13.7%, n=17) were identified as the most common contributing factors to delayed ASV treatment (Table 5).

Table 5: Distribution of snakebite cases by Anti Sanke Venom administration, adverse events, and delay reasons

Parameter	Frequency (100%, n=124)
Total ASV vials used	
<10 vials	3.23%
10 vials	23.38%
11-20 vials	41.93%
>20 vials	31.44%
Adverse Events	
Hypotension	8.06%
Hypertension	6.45%
Fever	5.65%
Tachycardia	4.83%
Rigors	4.03%
Tachycardia	3.23%
Bradycardia	0.81%
Itching	0.81%
Urticaria	0.81%
Abdominal Pain	0.81%
Reason for delay to receive ASV	
Transportation	28.20%
Delayed after PHC	13.70%
No one available for help at incidence place	11.30%
Hospital far away	10.50%
Patient ignorance	7.30%
No sense of damage	6.50%

In our study, it is observed that 96.78% of patients recovered and discharged, while 1.61% left against medical advice (DAMA) and 1.61% succumbed to mortality (Figure 1).

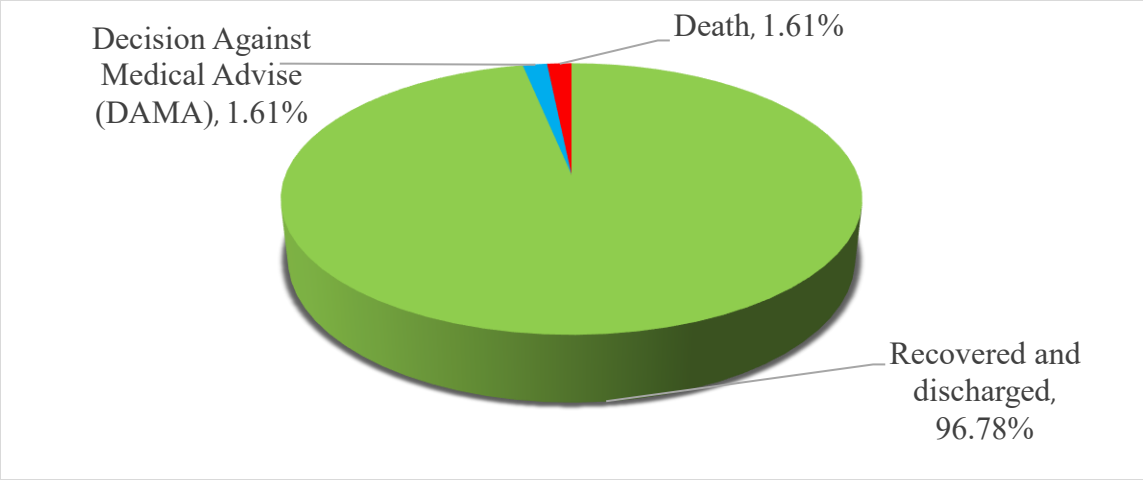

Figure 1: Clinical outcomes of snakebite victims.

DISCUSSION:

This study found a slightly higher incidence of snakebites among males (53.22%) than females (46.78%), with most victims 74% were in the age group 21 to 50 years followed 13% each below 21 years and more than 50 years. Of these, farmers 78.22%, servants 12.91%, and students 8.87%. Farmers being the most affected. Most cases were reported from peripheral areas of Aurangabad city, with rural areas (77%) having a higher incidence than urban areas (23%). The higher incidences among males and farmers with age group of 21-50 years are likely due to occupational exposure, these findings are consistent with the study, identifying snakebite as an occupational hazard among 54.4% farmers and 30.5% plantation workers,[17] mostly, people working in the rural areas with barefoot walking.[18] The work environment and timing of agricultural activities increase the risk of encounters with snakes.

Our study revealed that 34.7% of snakebite patients received first aid at PHCs, while 23.4% used tourniquets and 42.7% received no first aid. Notably, none of the patients applied the WHO recommended pressure immobilization technique.[5] These findings indicate a significant knowledge gap, consistent with a North Kerala study, which found 86% of participants had poor understanding of snakebite first aid and 93.6% used tourniquets, despite WHO warnings against their use.[19] These highlights indicate the need for public education on proper snakebite first aid measures.

Snakebite cases were identified and categorized based on clinical features and complications into vasculotoxic, neuroparalytic, and mixed-type envenoming. This study found vasculotoxic snakebites to be the most common (46.77%), followed by mixed type (42.74%), and neuroparalytic (10.48%). Based on the identified snake species, *Viper* bites accounted for 46.77% of cases, followed by *Russell's viper* (33.87%), *Cobra* (11.29%), and *Krait* (8.06%) bites, with *Viper* bites and *Russell*'s *Viper* bites being the most prevalent. Similarly, the study conducted at Maharashtra noted most of the victims were bitten by *Viper*,[20] in rural Maharashtra reported regional variations in snakebite incidence, with Echis carinatus (saw-scaled *Viper*) prevalent in humid coastal regions and *Russell's viper*, *Cobra*, and *Krait* more common in dry and hot climates.[21] The climate and geography of Aurangabad, Marathwada, Maharashtra, likely contribute to the higher incidence of *Viper* (vasculotoxic) and *Russell's viper* and *Cobra* (mixed type) and *Krait* (neuro paralytic) bites.

It was observed that amongst our study population, with proportionate to BNT the frequency of complications were increased cellulitis (14.10% to 100%), anemia (12.82% to 100%), uremia (10.26% to 22.22%), hypotension (1.28% to 22.22%), hematuria (3.85% to 11.11%), LRTI (6.67% to 16.67%), neutrophilia (50% to 100% and then to 55.56%), leukocytosis (47.44% to 83.33% and then to 66.67%), respiratory failure (7.69% to 50% and then to 11.11%), thrombocytopenia (12.82% to 50% and then to 33.33%), AKI (1.28% to 10%), and progressive swelling (15.38% to 33.33%). The neutrophilia (54.03%) with leukocytosis (51.61%), anemia (19.35%), thrombocytopenia (21.77%), cellulitis 21.57%), and progressive swelling (21.57% were the most prevalent manifestations than the AKI (3.22%), respiratory failure (10.48%), ARD (0.8%), HIE (0.8%) aligning with findings of the study, which reported significant complications including cellulitis (26.2%), acute kidney injury (20.9%), respiratory paralysis (4%), and ARDS (2%), among others the cerebrovascular events were noted in (n=9) patients,[22] whereas in our study the orthopedic (osteomyelitis at bite site) and gangrene complications were not observed this might because of our most of the study population had BNT less than 8 hrs. Similar findings where noted in previously conducted, the renal failure, leukocytosis, neurotoxicity, severe coagulopathy and adverse outcomes were observed in patients with prolonged BNT.[23] In our study, the frequent hematological complications were observed mainly due to most of the victims were bitten by vasculotoxic (*Viper*) and mixed type (*Russell's viper* and *Cobra*) snakes. In this study, it was observed that neuroparalytic

complications such as respiratory failure and ARDS were initiated in the victims within very short duration due to *Cobra* and *Krait* bites.

In the present study, almost 62.9% (n=78) of the total study population (n=124) comprised BNT 0-4 hours. Of these, 65.38% (n=51) of patients experienced complications, which included, cellulitis (14.10%, n=11), anemia (12.82%, n=10), uremia (10.26%, n=8), hypotension (1.28%, n=1), hematuria (3.85%, n=3), neutrophilia (50%, n=39), leukocytosis (47.44%, n=37), respiratory failure (7.69%, n=6), thrombocytopenia (12.82%, n=10), AKI (1.28%, n=1), progressive swelling (15.38%, n=12). The snakebite types in this BNT category were, *Viper* bites (29.03%, n=36), *Russell's viper* bites (22.58%, n=28), *Cobra* bites (6.45%, n=8), and *Krait* bites (4.84%, n=6). These findings are consistent with previous studies, which reported similar clinical manifestations and bitten snake species.[24,25,26] The hematological toxicity of *Viper* and *Russell*'s *viper* bites led to adverse outcomes, including neutrophilia, leukocytosis, anemia, and thrombocytopenia. Respiratory failure was observed in 7.69% of cases, likely due to the lower number of *Cobra* and *Krait* bites in this BNT category. According to previous research, *Cobra* and *Krait* venom can cause respiratory failure due to neuromuscular blocking action.

In the present study, almost 24.19% (n=30) of the total study population (n=124) comprised BNT 4-8 hours. Of these, 96.67% (n=29) of patients experienced complications, which included, cellulitis (16.67%, n=5), anemia (30%, n=9), uremia (6.67%, n=2), hypotension (13.33%, n=4), hematuria (6.67%, n=2), LRTI (6.67%, n=2), HIE (3.33%, n=1), septicemia (3.33%, n=1), neutrophilia (56.67%, n=17), leukocytosis (53.33%, n=16), respiratory failure (10%, n=3), ARDS (3.32%, n=1), DIC (6.67%, n=2), thrombocytopenia (36.67%, n=11), AKI (10%, n=3) and progressive swelling (33.33%, n=10). The snakebite types in this BNT category were, *Viper* bites (12.09%, n=15), *Russell*'s *viper* bites (7.26%, n=9), *Cobra* bites (3.23%, n=4), *Krait* bites (1.61%, n=2).These findings are consistent with the study, which reported similar critical complications, including AKI, DIC, sepsis, progressive swelling, respiratory failure, and ARDS, in patients with prolonged BNT.[14, 24] The present study suggests that vasculotoxic snake bites are frequently associated with critical complications, such as AKI, progressive swelling, septicemia, and DIC, while neuroparalytic bites can lead to respiratory failure and ARDS, as the BNT rises, likewise findings were revealed in a previously conducted study.[27]

In the present study, almost 4.84% (n=6) of the total study population (n=124) comprised BNT 8-12 hours. Of these, 100% (n=6) of patients experienced complications, which included cellulitis (16.67%, n=1), anemia (50%, n=3), LRTI (16.67%, n=1), neutrophilia (100%, n=6), leukocytosis (83.33%, n=5), respiratory failure (50%, n=3), thrombocytopenia (50%, n=3). The snakebite types in this BNT category were, *Viper* bites (0.8%, n=1), *Russell*'s *viper* bites (1.61%, n=2), *Cobra* bites (1.61%, n=2), and *Krait* bites (0.8%, n=1). The complications were more frequent and severe in this BNT category. Previously conducted studies, revealed that the delayed recognition and management can lead to life-threatening complications,[28,29] which aligned with the present study, the respiratory failure were observed among 50% amongst victims of this BNT category, this might be due to the *Cobra* and *Krait* bites with prolonged BNT, management of such cases were very difficult, as the complications turned in to the critical stages, many respiratory failure victims went through intubation, ventilator for oxygen support due to respiratory muscle paralysis. Moreover, it was observed that such patients had received medical intensive care services with closely clinical monitoring, consistent with findings reported by Patil et al. larger proportion of patients with delayed treatment required interventions such as fasciotomy, dialysis, and ventilator support. Notably, the need for dialysis and ventilator support was significantly ($p<0.05$) associated with delayed treatment.[13]

In the present study, almost 7.26% (n=9) of the total study population (n=124) comprised BNT 12-24 hours. Of these, 100% (n=9) of patients experienced complications, which included, cellulitis (44.44%, n=4), anemia (11.11%, n=1), uremia (22.22%, n=2), hypotension (22.22%, n=2), neutrophilia (55.56%, n=5), leukocytosis (66.67%, n=6), respiratory failure (11.11%, n=1), thrombocytopenia (33.33%, n=3). The snakebite types in this BNT category were, *Viper* bites (4.03%, n=5), *Russell*'s *viper* bites (2.42%, n=3), and *Krait* bites (0.8%, n=1). These findings align with the previous study, an exacerbated systemic complication due to delayed treatment reported.[30] The hematological toxicity and neurotoxicity worsened the victims' conditions due to delayed treatment, particularly due to *Viper*, *Russell*'s *viper*, and *Krait* bites. Managing such cases is challenging, required interventions such as blood transfusions, dressings, higher antibiotics, and prolonged ventilator support. In the present study, almost (0.81%, n=1) of the total the study population (n=124) comprised BNT >24 hrs. Of these (100%, n=1) patients had cellulitis and anemia complications. The victims falling in this BNT were, *Viper* bites (0.8%, n=1). The cellulitis was a common complication that increased from 14.10% to 100% in victims bitten by *Viper*, consistent with the study, which found cellulitis across all BNT categories, increasing in frequency with longer BNT, especially >24 hours.[30]

This study found a significant correlation between the timing of ASV administration and the development of complications in snakebite patients. Patients who received ASV within 0-4 hours of the bite had a lower incidence of complications (65.58%) compared to those who received ASV at later time intervals (96.66% for 4-8 hours, 100% for 8-12 hours, 12-24 hours, and >24 hours). Statistical analysis using the Chi-Square test revealed a significant correlation between BNT and complications (P-

value = 0.0015, 95% CI, p<0.05). Furthermore, Pearson Correlation analysis showed a strong positive correlation (r = 0.665) between BNT and complications. These findings are consistent with previous studies, which have also demonstrated a direct relationship between delayed ASV administration and increased risk of complications in snakebite patients,[31,32] The delayed ASV administration indicates the increased BNT which reflects increased duration of venom stay in the body of the victims and thus proportionately enhances the risk of development of complications.

In our study, it is observed that, the majority of patients (41.64%) received 11-20 vials of ASV, with a recovery rate of 96.77%, however the majority of our study patients had BNT 0-8 hrs. Notably, starting with a low dose of ASV (minimum 10 vials) resulted in better patient improvement, suggesting that subsequent doses should be tailored to individual clinical conditions and response to ASV. These findings are consistent with previous research, including a study, they found no significant difference in outcomes between low-dose (<50 ml or ≤5 vials) and high-dose (>50 ml or >5 vials) ASV groups, with most patients surviving with low doses when treated promptly. [33] As in present study most of the patients received ASV within 0-8 hrs. with <10 and 10-20 vials, though patients had many complications however the recovery rate was good. A review of 5 randomized controlled trials, also suggested that low-dose ASV may be equivalent to or better than high-dose ASV in treating venomous snakebites, depending on patient clinical status.[34] although the evidence quality was graded as "very low".

This present study found that adverse events after ASV administration were mostly mild to moderate, including hypotension (8.06%), hypertension (6.45%), fever (5.65%), tachycardia (4.83%), tachypnea (3.23%), and rigors (4.3%). Less common events included bradycardia, itching, urticaria, and abdominal pain. All adverse events were resolved with medications such as adrenaline, hydrocortisone, phenylephrine, and paracetamol, whereas a study revealed, chills, nausea, and vomiting as common adverse reactions, with some patients had severe reactions like hypotension and respiratory arrest.[35] Prophylactic use of medications may have contributed to the low incidence of adverse events in the present study.

In this study, reasons for delayed to reach at hospital for ASV treatment and supportive management were observed as transportation in 28.2 % (n=35) of patients, delayed after PHC in 13.7 % (n=17) of patients, no one available for help at the time of incidence place in 11.3 % (n=14) of patients, hospital far away in 10.5 % (n=13) of patients, patient ignorance in 7.3 % (n=9) of patients and no sense of damage in 6.5 % (n=8) of patients. Transportation and delayed after PHC were the two major reasons in most of the patients, similar findings align with the study, revealed ASV treatment delay due to lack of awareness of snakebite hazards, lack of transportation and referral facilities,[36,37] another study noted that snake bite victim died on the way due to poor access to nearest hospital,[21] in one of the previously conducted study, the 3 patients were died out of 18 patient snake bite envenomation because of lacking prompt medical facilities and inadequate antivenom,[38] these findings indicating, it is essential to have availability of ASV at PHCs and nearby hospitals to get it promptly by snake bite victims. A retrospective chart review study of 533 snakebite victims in India, found that pre-hospital delays over 24 hours resulted in 18% mortality,[39] compared to 5% mortality for those hospitalized within a shorter timeframe, this study concluded that complications and mortality are directly related to the timing of ASV administration. In the present study, the higher recovery rate of 96.78% and least death rate 1.61% are probably due to most of the victims 62.90% and 24.19% having received ASV with supportive medical management within 0-4 hrs. and 4-8 hrs. respectively, however the large number of victims had complications. The victims who received ASV within 0-4 hrs. had lower complication rate (34.4% without complications) compared to those who received ASV within 4-8 hours (3.33% without complications) and for those whose ASV receiving time delayed over 8 hrs., 100% of patients had complications. Timely administration of anti-snake venom (ASV) can significantly reduce mortality and morbidity associated with snakebites. Integrating snake antivenoms into primary healthcare systems is crucial in regions prone to snakebites. Delayed medical care often stems from diverse factors, including geographical disparities, snake species diversity, inadequate reporting, reliance on traditional remedies, and limited healthcare access.[40] These findings highlight the importance of prompt ASV administration and public awareness to minimize delays, reduce complications thus, reduce morbidity, mortality, and save lives.

CONCLUSION:

This study concluded that, despite being preventable, snakebites envenoming remains a life-threatening medical emergency, particularly affecting rural agricultural and farming communities. Snakebite envenoming complication rises in proportionately to the BNT, as the statistically significant, strong positive correlation exists between BNT and complications. Thus, this study highlights the imperative role of timely ASV administration in preventing complications and reducing morbidity and mortality associated with snakebites and underscores the need for public awareness on appropriate first aid measures, prompt ASV and supportive medical intervention, ultimately enhancing patient outcomes and quality of life.

RECOMMENDATION:

Providing health education on snakebites at rural and urban areas, their toxic effects, importance of prompt hospitalization, ASV therapy, right first aid and preventive measures can significantly reduce the incidence and complications of snakebites.

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ABBREVIATIONS:
%: Percentages.
AE: Adverse Event.
ARDS: Acute Respiratory Distress Syndrome.
ASV: Anti-Snake Venom.
BNT- Bite-to-Needle tile.
CI: Confidence Interval.
CRF: Case Report Form.
DAMA: Discharged Against Medical Advice.
DIC: Disseminated Intravascular Coagulopathy.
HIE: Hypoxic Ischemic Encephalopathy.
PHC: Primary Health Centre.
IEC: Institutional Ethics Committee.
LRTI: Lower Respiratory Tract Infection.
MS Excel: Microsoft Excel.
n: Frequency of cases.
RF: Respiratory Failure.
WHO: World Health Organization.

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