Original Research Article

Clinico-Epidemiological Study and Outcome of Snakebite Cases in Western Ghats of South India Done at a Tertiary Care Centre

Abstract

Background & objectives: Snakebite is a notable public health problem in tropical and sub-tropical geographical zones. Management of snakebites require through examination, careful monitoring of vitals and assessment of envenomation. The epidemiological and clinical management data will provide an insight on the critical management issues and varied presentation.

Methods:A retrospective observation study was conducted at Shripad Hegde Kadave Institute of Medical Sciences, Sirsi, Uttara Kannada district of Karnataka. Patients admitted to the hospital during the period from Jan 2019 to Aug 2022 were included for the study.

Results: The data from a total of 78 participants was included for the analysis. The mean age was 38.56±17.28 years. The majority of participants 50(64.10%) were male and farmers by occupation. Majority of cases had haematotoxic symptoms (42.2%) followed by myotoxicity (33.3%). Predominant neurotoxicity was seen in only 2(2.56%) of patients.57 (73%) of participants had elevated INR ratio.67(85.9%) participants were medically managed and 10 (12.82%) required surgical intervention. 3(18.75%) participants had Acute Kidney Injury. With respect to the final outcome, 71(91%) of participants were discharged after recovery.

Interpretation &Conclusion: This study provided the vital insight on clinical presentation and management of snakebite in western ghats of south India. Snakebite majorly affected male and middle-aged people. Farmers were most affected and bites occurred during monsoon season. Due to variation in local distribution of species of snakes (predominantly vipers)

Comment [JVAP1]: Consider changing title: **Clinico-Epidemiological Study Doneat a Tertiary Care Centreand Outcome of Snakebite Cases in Western Ghats of South India**

Comment [JVAP2]: Is it notable or merely neglected tropical disease? Kindly correct if agree as NTD as indicated by WHO.

Comment [JVAP3]: Some grammatical errors hence require the whole manuscript a thorough English proficiency proofread.

Comment [JVAP4]: Can here be included the type of snake involved in the snakebite? Example low bites involving kraits or cobras to be included within the text. If possible do include.

Comment [JVAP5]: You can also include in this statement low bites were reported due to kraits and cobras here.

haematotoxicsymptoms and signs were the major clinical presentation. The outcome was relatively better compared to other studies in India with 91% recovery.

Comment [JVAP6]: Nothin in abstract suggested such outcome hence remove this conclusion.

Keywords: Snakebite, Haematotoxic, SouthIndia, Epidemiology.

Introduction

Snakebite is an issue of public health importance in tropical and sub-tropical geographical zones. Snakebite is a neglected tropical disease. It was added to this list in 2017[1]. World Health Organization estimates (WHO) about 5.4 million snake bite incidents happen each year, which results in 1.8 to 2.7 million cases of envenomation. The death estimates due to snake bite ranges between 81,410 and 1, 37,880 each year. The amputations and permanent disabilities are 3 times the deaths [2]. As per estimates of India from Indian Million death study from 2001 to 2014 and systematic reviews of studies from 2000 to 2019, the deaths due to snake bites in India is 1.2 million (average 58,000/year). The estimated snakebites is 1.11 – 1.77 million bites per year and 70% resulting in envenomation[3].

Comment [JVAP7]: If it is an importance why WHO classified it as neglected tropical disease? Discuss here on this NTD.

Comment [JVAP8]: No latest records?

Most of the species of snakes in India (236 species) are non-poisonous. Only 13 species of snakes found in India are poisonous out of which maximum envenomation is due to 4 species only. The four important poisonous species are Cobra, Russell viper, Saw- scaled viper and common krait. Most venomous snake bite is from Common krait [4]. Most common population affected by snakebite are farmers, plantation workers, people living in poor environmental condition and people of low socio-economic status. The burden is sometimes underestimated as many of the victims of snakebite fail to reach health care centre and are treated by traditional healers and quacks [5]. Management of snakebites require through examination, careful monitoring of vitals and assessment of envenomation and accessibility of anti-snake venom serum (ASV). These factors have a significant impact on the outcome [6].

Comment [JVAP9]: Use term of non-venomous instead of non-poisonous for obvious reasons.

Comment [JVAP10]: venomous please instead

Snakebite incidence and mortality varies from region to region. Karnataka state situated in south India has a significant burden. In Karnataka the prevalence of snakebite is 20.3 per 100,000

Comment [JVAP11]: include the year this prevalence is to be indicated up to in text. Up to which year this prevalence been reported? is it up to 2023?

population and death is 1.23 per 100,000 population[7]. The regional epidemiological data is vital in understanding the demographic and socioeconomic factors affecting the incidence and outcomes. The clinical management data will provide an insight on the critical management issues and varied presentation. This will help in developing customized regional clinical protocols. Hence this study was performed to understand the clinical and epidemiological profile and outcomes of snakebites from Western ghat region of Karnataka.

Comment [JVAP12]: Low compared to other mainstream diseases such CVD and cancer and that is why it is termed as NTD unfortunately.

Materials and Methods

Aretrospective observation study was conducted at Shripad Hegde Kadave Institute of Medical Sciences, Sirsi, Uttara Kannada district of Karnataka. The patients admitted to the hospital following snake bite were included in the study. The details of these patients which include demographic details, clinical history, presentation and management was obtained from the hospital medical records. Patients admitted to the hospital during the period from Jan 2019 to Aug 2022were included for the study. The Institutional Ethics committee approval was taken prior to conduct of the study.

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Comment [JVAP14]: Need the approval number and the official name of the HEC here

Statistical Methods

The variables were analysed using appropriate statistical test. The descriptive analysis was done using the mean and standard deviation for quantitative variables. Frequency and proportion were used to analyse categorical data. Data was analyzed by using coGuide software, V.1.3.[8]

Results

Comment [JVAP15]: After reading the results in my opinion best for readers if you combine results with discussion rather than separating them. Kindly combine as one section of Results & Discussion instead. Also,why in texts the results section and later also given tables and figures (graphs) after references (redundant). Too much texts as results. Only graphs and tables will do.

Comment [JVAP16]: Any reason for the wider range of age gap between the males and females here? Please discuss if not done so yet.

The data from a total of 78 participants was included for the analysis.

In the study population, the mean age was 38.56±17.28 years wherein the range of age was 3 years to 82 years.The majority of participants 50 (64.10%) were male and 28 (35.9%) participants were female. Majority of participants 74 (94.87%) were living in rural area. The occupation of the patients was analysed. The results showed that 43 (52.12%) were farmer, 15 (19.23%) participants were student, 13 (16.67%) were housewives.

The site of bite was in upper extremity for 25 (32.05%) participants and in lower extremity for 53 (67.95%) participants. The place of bite was outdoor for 65 (83.33%) participants and indoor for 13 (16.67%) participants. With respect to time of bite 25 (32.05%) participants reported morning time of bite, 10 (12.82%) participants reported noon time of bite, 38 (48.72%) participants reported evening time of bite. To assess the seasonality of snake bite the whole year was divided into 4 quartiles of 3 months each. 11 (14.1%) participants had bite in the 1st quartile, 23 (29.48%) participants had bite in the 2nd quartile, 20 (25.64%) participants had bite in the 3rd quartile, 24 (30.77%) had bite in the 4th quartile. With respect to species of snake, in 23 (29.49%) bites species was unknown, 33 (42.3%) were Russell viper, 12 (15.38%) were viper (local species), 2 (2.56%) were saw scaled viper, 4 (5.13%) were cobra, 4 (5.13%) krait. The mean Time duration between snakebite and access to FRU was 255.77±396.72 minutes with the range (15, 2460)

In the study population, 67 (85.9%) participants had swelling, 12 (15.38%) participants presented with cellulitis, 3 (3.84%) participants had breathlessness, 2 (2.56%) participants had neck weakness, 2 (2.56%) participants had unconscious, 4 (5.13%) participants had ptosis, 1 (1.28%) participants had slurring of speech symptoms. The whole blood clotting time was abnormal in 36 (46.15%) of participants on presentation.

In the study population, 57 (73%) of participants had elevated INR ratio. Liver dysfunction was seen in 3 (3.84%), Hypoalbuminemia in 2 (2.6%) and Hyperkalemia in 1 (1.28%) of the participants.

With respect to type of management, 1 (1.28%) participants was managed conservatively , 67 (85.9%) participants were medically managed and 10 (12.82%) required surgical intervention along with medical management. 8 (10.26%) participants required administration of neostigmine for neurotoxicity symptoms, 39 (50.00%)participants required ICU support, 4 (5.13%) participants were on ventilator, 4 (5.13%) participants required blood product transfusion, 2 (2.56%) participants requireddialysis therapy. In type of complications, 3(18.75%) participants had Acute Kidney Injury and 11 (68.75%) participants required wound debridement after 1 week.

With respect to the final outcome, 71 (91%) of participants were discharged after recovery. 3 (3.84%) participants were Discharged Against Medical Advice (DAMA). Among the patients admitted 2 patients were referred to other centers and 1 patient among them died with acute kidney injury (AKI) and disseminated intravascular coagulation (DIC).

Discussion

Comment [JVAP17]: Have each result aligned to its discussion for better readability. Thanks

The results from the study gives an insight on the clinic-epidemiological profile of snakebite cases. Majority of participants 50 (64.10%) were male. This is similar to other studies conducted in northern and southern India wherein majority of snakebite victims were male [9,10]. The mean age of the patients in this study was 38 years. This is similar to the studies where in the majority of victims are of middle age [10,11]. In our study majority of participants 74 (94.87%) were living in rural area and 43 were farmer (52.12%). This is similar to another study conducted in Karnataka which showed that maximum 93% of snakebite patients were farmers [12]. Snakebite

can be considered as one of the occupational hazard of farming wherein there is more exposure to the field and most of these farmers will be male and of middle age.

With respect to characteristics of the snakebite, the site of bites were in lower extremities and in outdoors. Most bites happened in the evening. These results are similar to other studies which gives an idea about the behaviour of snakes and expected interaction with humans [13,14]. In our study we analysed the seasonality of snake bite. There was no significant difference in the seasonality but maximum bites were during 2nd and 4rd quartile that is April to September. This is similar to other studies done in India which showed maximum bites happen during the monsoon season in India. There is more agriculture activity and flooding of the natural habitat of snakes thus increasing human interaction. In Southern India, Halesha BR et.al showed that majority bites happen in July to September [12]. and study in Davangere by Haladiet,al showed bites occur between May to August[15]. The bite mark was visible in 97% of cases which is more than study done in Kerala by Kumaran et.al which showed 88% of cases had bite marks[10].

In this study majority of cases had haematotoxic symptoms (42.2%) followed by myotoxicity (33.3%). Predominant neurotoxicity was seen in only 2 (2.56%) of patients. These features are similar to studies done in South India where hematoxicity was predominant [10,13,15]. The Northern part of India shows predominant neurotoxic presentation due to the variation in distribution of species of snake between north and south India [16]. Local swelling at the site of bite was the main clinical presentation in this study. This is similar another study by Thapar et.al in South India which showed localised swelling as the main clinical presentation[17].

In this study, elevated INR ratio was seen in 73% of the patients, this is high compared to study conducted in North India which showed 20% of snakebite patients had increased INR ratio [9]. This variation maybe due to difference in snake species.

In this study 8 (10.26%) participants required ICU support, 4 (5.13%) participants were on ventilator, 4 (5.13%) participants required blood product transfusion, 2 (2.56%) participants had

dialysis therapy. In type of complications, 3(18.75%) participants had Acute Kidney Injury. A study from North India showed that the complications followed by snake bite included respiratory failure requiring mechanical ventilation (41.6%), bleeding manifestations (haematuria) 28.3%, hypotension (28.3%) and acute kidney injury in 6.6% cases[18]. Mean duration of stay in hospital is 2.55 days in our study. Patients with more complications stayed longer in hospital. Duration of hospital stay (4 days) was comparable with other studies [16].

With respect to the final outcome, 71 (91%) of participants were discharged after full recovery. 1 participantswho was referred to other center died with disseminated intravascular coagulation (DIC) and acute kidney injury (AKI). In study conducted in North India showed death in 9.3% of cases and major reason was neurotoxic symptoms with respiratory failure[9]. Study done in Kerala showed that 13.5% death with hematotoxic symptoms succumbed to DIC and AKI[10]. Other studies done in Karnataka did not report any death in their studies.

Conclusion

Snakebite is a public health issue in the tropical and subtropical countries. This study provided the vital insight on clinical presentation and management of snakebite in western ghats of south India. Snakebite majorly affected male and middle-aged people. Farmers were most affected and bites occurred during monsoon season. Due to variation in local distribution of species of snakes (predominantly vipers) haematotoxicsymtpoms and signs were the major clinical presentation. Increased INR ratio was seen in 73% of patients. Acute kidney injury complication was seen in 3 patients. The outcome was relatively better compared to other studies in India with 91% recovery.

Declarations:

Ethical and informed consent: Ethical approval was obtained from the institutional review board of the centre concerned. Informed written consent was obtained before the study started and confidentiality was maintained throughout.

Comment [JVAP18]: In discussion given results either not given earlier in results section or given again to be redundant so consider one section of results & discussion unless journal forbids so.

Comment [JVAP19]: Why only this population. Include the possible reason here.

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Table 1: Demographic Characteristics of the Patients with Snake Bite

	Parameters	Summary
	Age (years)	38.56±17.28 (ranged 3, 82)
Gender	Male	50 (64.10%)
	Female	28 (35.9%)
Locality	Rural	74 (94.87%)
	Urban	4 (5.13%)
Occupation Category	Student	15 (19.23%)
	Farmer	43 (52.12%)
	Housewife	13 (16.67%)
	Daily Wage Worker	5 (8.255%)
	Children	2 (2.56%)

Table 2: Description of Characteristics of The Snake Bite

	Parameters	Summary
Site of Bite	Upper Extremity	25 (32.05%)
	Lower Extremity	53 (67.95%)
Seasonality (quarterly)	1st	11 (14.1%)
	2nd	23 (29.48%)
	3rd	20 (25.64%)
	4th	24 (30.77%)
Place	Outdoor	65 (83.33%)
	Indoor	13 (16.67%)
Time of bite	Morning	25 (32.05%)
	Noon	10 (12.82%)
	Evening	38 (48.72%)
	Midnight	2 (2.56%)
	Night	3 (3.85%)
Bite Mark	Yes	76 (97.44%)
	No	2 (2.56%)
Species of snake	Unknown	23 (29.49%)
	Russell viper	33 (42.3%)
	Viper	12 (15.38%)
	Saw sculled viper	2 (2.56%)
	Cobra	4 (5.13%)

Table 3: Description of the Presenting Symptom of Snake Bite

	Parameters	Summary
Symptoms		
• **Local Envenomation**	Swelling	67 (85.9%)
	Cellulitis	12 (15.38%)
• **Neurotoxic symptoms**	Breathlessness	3 (3.84%)
	Neck weakness	2 (2.56%)
	Unconscious	2 (2.56%)
	Ptosis	4 (5.13%)
	Slurring of speech	1 (1.28%)
• **Other Symptoms**		14 (17.95%)
20 min Whole Blood Clotting Test	Normal	42 (53.85%)
	Abnormal	36 (46.15%)
Toxicity	Hematotoxicity	33 (42.27%)
	Myotoxicity	26 (33.33%)
	Neurotoxicity	2 (2.56%)
	Non toxic	6 (7.69)
	Neurotoxicity and hematotixicity	6 (7.69%)
	Hematotixicity and myotoxicity	5 (6.41%)

Table 4: Description of Biochemical Parameters of Snakebite Patients

Parameters	Summary
Elevate INR ratio	57 (73%)
Hepatic dysfunction	3 (3.84%)
Hypoalbuminemia	2(2.6%)
Hyperkalaemia	1(1.28%)

Table 5: Description of Management of Snake Bite Patients

Parameters	Summary
Intervention	
Conservative	1 (1.28%)
Medical	67 (85.9%)
Medical and surgical	10 (12.82%)
Neostigmine used	8 (10.26%)
Anti-snake venom used	66 (84.61%)
ICU support	39 (50.00%)
Ventilator requirement	4 (5.13%)
Blood or blood product transfusion	7 (8.97%)
Dialysis therapy	2 (2.56%)
Length of stay in hospital in days (N=77)	2.55±1.60 (0.5, 8)
Type of complications (N=16)	
AKI	3(18.75%)
Debridement after 1 week	11 (68.75%)

Table 6: Description of Outcomes of Snake Bite Patients

Final outcome	Summary
Discharged	71 (91%)
Discharged Against Medical Advice (DAMA)	3 (3.84%)
Referred to other centres	2 (2.56%)
Not admitted	1 (1.28%)
Death	1 (1.28%)