

A Comprehensive Study of Patients Admitted with Snakebite in Tirunelveli Medical College Hospital

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Abstract

Background: Patients admitted with snakebite can have varied manifestations and complications which needed special care and specialized treatments. To alert the treating physician about the possible presenting symptoms and signs and the possible complications, we need some baseline information about the incidence of snakebite in that given area, the most common type of snake and percentage of patients develops complications, the mortality, and outcome. This study was conducted to provide such information.

Aim: This study aims to study the incidence of snakebite, complications, and predicting the outcome based on variable factors in patients >12 years of age.

Materials and Methods: It was a prospective observational study done in 403 patients admitted in the study period of 1 year (from May 2017 to April 2018). Around 20 parameters were recorded using pre-structured pro forma. Data analyzed using SPSS software version 21.0.

Results: A total of 403 patients were studied. Only 56% of patients showed signs of envenomation; among this the most common is the cellulitis which accounts for 36.4% of patients. The study also showed that those who were presenting late had increased morbidity and mortality and their stay in the hospital also prolonged. It also showed that almost 5% of patients still underwent some form of unauthorized treatment before seeking the medical care. Increase in age is associated with bad outcome. The study also showed 21% of all patients who had snakebite developed complications; the most common was the compartment syndrome accounted for 8.9%. Only in 46% of cases, the snake was identified and the Russell's viper is the most common snake responsible for most of the bites.

Conclusion: Late visit following snakebite is the most important factor which inversely affects the outcome following snakebite. Other factors which contribute to poor outcome include old age, diabetes, native treatment, presence of signs of envenomation on admission, and development of complications.

Key words: Complications, Morbidity, Mortality, Snakebite

INTRODUCTION

Being bitten by a snake is frightening for all. Most of the snakebites produce little more than local pain and do not require medical attention. However, some bites may produce life-threatening complications hence seeking medical attention immediately after bite is mandatory to avoid mortality and morbidity. The terms venomous

and poisonous are not the same. "Venomous" indicates organisms producing toxic material in the specialized gland and injecting through bite specialized venom apparatus and other means. "Poisonous" refers to detrimental effects produced by touching or consuming plants/organisms. Poison found throughout the organisms but venom produced in isolated glands. Most of the world's medically significant snakes belong to four families – *Viperidae*, *Elapidae*, *Colubridae*, and *Atractaspidinae*.^[1,2] In developing countries, most of the snakebites occur to the agricultural workers during their work in the fields. In developed countries, the most common victims are adolescents and young adults due to their risky behavior. About >95% of snakebites occur over lower extremities.^[3] Snake venoms are complex mixtures of proteins including

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enzymes and low-molecular-weight polypeptides. The fear of snakebite itself produces symptoms such as nausea, vomiting, diarrhea, cold clammy skin, and syncope regardless whether injection of venom.^[4] In general, viper bites cause deleterious effects on almost any organ system. Russell's viper is implicated in causing acute kidney injury (AKI) and neurotoxicity apart from the usual local signs and coagulation abnormalities.^[5] In contrast, *Elapidae* family causes more neurotoxic manifestations with little or no envenomation. Exceptions are African spitting cobras (member of *Elapidae* family) produce little or no neurotoxicity but cause severe tissue necrosis and vipers such as Southern Pacific rattlesnake (*Crotalus oreganus helleri*), timber rattlesnake (*Crotalus horridus horridus*), western diamondback rattlesnake (*Crotalus atrox*), and Mohave rattlesnake (*Crotalus scutulatus*) produce significant neurotoxicity.^[6] Krait bites are commonly painless and produce neurotoxicity which will not resolve following administration of anti-snake venom (ASV) or anticholinesterase due to postsynaptic blockade. Sea snakes produce generalized rhabdomyolysis later lead to respiratory failure.^[7]

Aim

This study aims to study the incidence of snakebite, complications, predicting the outcome, and mortality rate.

MATERIALS AND METHODS

In this prospective observational study, patients with snakebite admitted in the Department of General Medicine at Tirunelveli Medical College were included in the study.

Inclusion Criteria

The following criteria were included in the study:

- All known cases of snakebite patients
- Age group >12 years
- All known case of bronchial asthma and chronic obstructive pulmonary disease (COPD) without any acute exacerbation before a snakebite
- All the cases of ischemic heart disease/diabetes/hypertensive/epilepsy with snakebite.

Exclusion Criteria

The following criteria were excluded from the study:

- Age <12 years
- Doubtful bites (patient not sure about what bite them)
- Snakebites (patient found snake beside them at night)
- Known cases of hemophilia and other coagulation disorders
- Known cases of chronic kidney disease/who already undergoing dialysis
- Known cases of sepsis with AKI (before the incidence of snakebite)

- Known cases of patients with cellulitis in the same limb due to other causes apart from snakebite
- Known cases of COPD patients with severe respiratory distress
- Known cases of bronchial asthma with previous episodes of status asthmaticus presenting with respiratory failure onset before the snakebite.

RESULTS

In our study, 403 snakebite patients were selected during the 1 year period (from May 2017 to May 2018) based on inclusion and exclusion criteria, observed, and subjected to relevant investigations and results are compiled. In our study, males (65%) are found to have more incidence of snakebite than females (35%). In our study, most of the patients had the snakebite when they were outside of their home. Among the 403 snakebite patients, we studied around 5% of people (20) underwent some form of unauthorized method of treatment before seeking medical care. The people who went some form of traditional or unauthorized method of treatment show increased

Table 1: Presenting symptoms

Symptoms	No	Yes	Percentage
Pain and swelling	243	160	39
Bleeding	380	23	5.70
Muscle weakness	361	42	10.40
Gastrointestinal symptoms	393	10	2.40
Breathlessness	369	34	8.40

Table 2: Autonomic hyperactivity

Autonomic hyperactivity	No	Yes	Percentage
Hyperglycemia	379	24	5.90
Hypertension	390	13	3.20
Sweating	359	44	10.90
Tachycardia	340	63	15.60

Table 3: Envenomation signs

Signs of envenomation	Yes	No	Percentage
Cellulitis	147	256	36.40
Whole blood clotting test >20	121	282	30
Neuromuscular weakness	46	357	11.40

Table 4: Complications of snakebite

Complications	No	Yes	Percentage
Acute kidney injury	376	27	6.6
Compartment syndrome	367	36	8.9
Disseminated intravascular coagulation	394	9	2.2
Respiratory failure	379	24	5.9
Sepsis	380	23	5.7

Table 5: Number of complications

Number of complications	Frequency	Percentage
1	342	84.80
2	41	10.10
3	11	2.70
4	8	1.90
5	1	0.20

Table 6: Outcome

Outcome	No	Yes	Percentage
Completely recovered	44	359	89
Disabilities	370	33	8.1
Death	392	11	2.7

Table 7: Complete recovery based on number of complications

Number of complications	Death		Total	P-value
	No	Yes		
1	307	2	309	<0.0001
2	23	45	68	
3	10	7	17	
4	7	1	8	
5	1	0	1	
Total	44	359	403	

Table 8: Morbidity based on number of complications

Number of complications	Death		Total	P-value
	No	Yes		
1	45	23	68	<0.0001
2	10	7	17	
3	7	1	8	
4	1	0	1	
Total	370	33	403	

Table 9: Mortality based on number of complications

Number of complications	Death		Total	P-value
	No	Yes		
No	309	0	309	<0.0001
1	67	1	68	
2	14	3	17	
3	2	6	8	
4	0	1	1	
Total	392	11	403	

morbidity (20%) and mortality (10%) than who do not. The snake was correctly identified either with a history of with the help of photographs is in only 46% of the patients. In remaining, the identification was not possible. In more than half of the patients, snakes were not identified. Among the identified snakes, Russell's viper is the most common snake

type accounts for 23% of the cases and least common is krait 10%. The most common presenting complaints in our study is that of pain and swelling at the bite site and least common is the gastrointestinal symptoms (such as vomiting and abdominal pain Table 1). Out of all patients presented with snakebite, only few show the signs of autonomic hyperactivity. Among the most common manifestation was the tachycardia (15.6%) followed by sweating and palpitation (10.9%). Hyperglycemia and hypertension were also not in few Table 2. Out of 403 snakebite patients studied, only 226 (56%) patients showed the sign of envenomation and 177 (44%) patients showed no evidence of envenomation. Among 226 patients who showed signs of envenomation, cellulitis is the major sign followed by the prolonged clotting time and the last is the neuromuscular weakness Table 3. Among the study patients, around 9% were diabetic and 7.4% were hypertensive. Two patients gave a history of pulmonary tuberculosis in the past and eight people had bronchial asthma (mild) who used intermittent inhaler therapy. In our study population of 403 patients, 86 patients (21%) had comorbid conditions. The contribution of these comorbidities in the outcome of the patients had been considered in the studies. Among the 403 patients without snakebite, 61 (15.1%) developed one or more complications. Compartment syndrome (8.9%) is the most frequent complication encountered in the study population. Disseminated intravascular coagulation (DIC) (2.2%) is the least common complication observed in the study group. Among 61 (15.1%) who developed complications, 41 patients (10.1%) had single complication, 11 patients (2.7%) had two complications, 8 patients (1.9%) two complications, and one had four complications Tables 4 and 5. The overall outcome was good for the patients admitted with snakebite. Three hundred and fifty-nine (89%) patients recovered completely following snakebite, 33 patients had morbidity, and 11 patients expired due to complications of snakebite. The patient who presented to the hospital early following the snakebite had good outcome. The delayed presentation resulted in increased morbidity and mortality. According to the study result, patients with young age had good recovery Table 6-9. The mean age of <40 has favorable outcome than the mean age of >40 in the study population. Diabetes is one of the factors play a pivotal role in the outcome of the patients. Around 50% of patients who had morbidity and mortality had diabetes. DIC increases the risk of mortality significantly in patients with snakebite but if treated properly does not produce any morbidity and recovery is complete. According to our study, all the patients who developed respiratory failure showed some kind of neuromuscular weakness. Some patients who showed muscular weakness did not develop respiratory failure due to the treatment given. All the patients who died had cellulitis. Cellulitis increased morbidity significantly. Twenty-nine out of 33 patients who had morbidity had

cellulitis. Cellulitis is one of the major factors which significantly prolonged the hospital stay in snakebite patients. Whole blood clotting test not significantly affects the outcome of the patients. It signifies the risk of the development of DIC, but much of the abnormality corrected by administration of ASV. Patient's outcomes did not greatly vary between those who have prolonged clotting time from those who have normal clotting time. Although neuromuscular weakness leads to respiratory failure and needs for ventilatory support subsequently increased, the outcome is not significantly affected. Out of 46 presented with weakness, 39 recovered completely, only 5 developed some kind of morbidity, and death occurred in 2 of the patients. Sepsis is the major complication which increased the mortality of the patients among 11 people who died 10 developed sepsis. Early treatment of sepsis can prevent mortality. The number of snakebite cases admitted in Tirunelveli Medical College is maximum at mid-year period. May month has the maximum number of cases (49) and February month had the least number of cases (20) followed by September (24). Those who had fewer complications had good clinical recovery than those had more complications. The number of morbidities also increased proportionately with increased number of complications. The number of deaths increases with increasing complications. Among 68 people with single complication, one died but the number increases with 3/17 for two complications, 6/8 for three, and 1/1 for patient who developed four complications.

DISCUSSION

In this study, all the 403 patients admitted to Tirunelveli Medical College Hospital for the period of 1 year (from May 1, 2017, to April 30, 2018) with the definite history of snakebite were studied since the admission till the final endpoint (discharge/death). About 95.30% of bites have occurred when the patients were outside their home (384 patients) and bites were common in rural areas and among the farmers and agricultural laborers. Other activities that are having increases risk of exposure the snakebites are collecting long, gardening, and playing or working near the bushy areas. This is the similar case mentioned in the article^[8] patients (4.7%) who had their bite inside their home were in their sleep and snake was not identified in the majority, but in some cases, the snake was identified and it belongs to the krait variety. This is comparable to Faiz *et al.*,^[9] Ariaratnam *et al.*,^[10] and Sharma *et al.*^[11] where the snake responsible for bite during the sleep is krait in India, Sri Lanka, and Nepal.

During the 1 year study period, the total number of

snakebite patients admitted was 403. This contributed to 1.7% of all the admissions (24,847 patients) in our medicine department. The mortality due to snakebite was 11 in our study period which accounted for 0.6% of overall mortality. The practice of unauthorized mode of treatment was present in 20 patients (5%) and the most common method is application of tourniquet above the bitten area followed by incision with sharp objects at the bite site. The morbidity (four patients) and mortality (two patients) showed significantly high in patients underwent treatment by other means; this is partly due to unwanted delay occurs before seeking medical care and administering ASV. It is also due to manipulation at the bite site increases the risk of secondary bacterial infection producing significant sepsis and related complications and decreased blood supply due to tight application of tourniquet aggravates the local effects of envenomation and favors necrosis. This is also mentioned in Pe *et al.*,^[11] Guderian *et al.*,^[12] and Bush *et al.*^[13] The incidence of morbidity is in rising when the age of the patient increases. The mean age of 40 and below is having favorable outcome than the patients with mean age of ≥ 48 . The mortality also increases with age due to the presence of comorbidities which significantly affects the outcome of the patient. This is as same as mentioned in the study by Mohapatra *et al.*^[14] where there are 46,000 snakebite deaths in India per year accounts for 0.5% of all overall mortality. However, in our study, the percentage of admission and deaths was compared with our hospital admissions and deaths in our hospital not with the general population. Among the 403 patients who had the definite snakebite, only 220 patients (56%) showed some form of envenomation. One hundred and seventeen patients (44%) showed no symptoms or signs even though definitely bitten by snake accounts for "dry bites" which is comparable to Warrell *et al.*^[15] and Warrell.^[16] The bitten snake was identified in only 46% (184 patients) and 54% of patients not identified the snake even with the help of photograph. Since most of the bite occurred in the evening and night than the day and the location of bite is outdoor mostly in congested areas, the identification was not possible in most cases. Among the snakes identified, most of the bites are produced by vipers, especially Russell's viper accounts for most of the bites (37%) followed by saw-scaled viper (30%). Cobra (23%) and krait (10%) are the most commonly responsible for the neurotoxic snakebites but Russell's viper also produces some neurotoxicity in three patients but not amounting to respiratory failure; Wüster *et al.*,^[17] the most common presenting symptom following snakebite is pain and swelling at the bite site accounts for 39% of cases and least common is gastrointestinal symptoms (2.4%). Some patients showed signs of autonomic arousal on arrival to hospital and the most common sign is tachycardia

presented in 15.6% of patients. About 5.9% (24) of patients had hyperglycemia on arrival which disappeared on follow-up period and their glycosylated hemoglobin showed no significant abnormality. Among our study patients, 37 were diabetic which has significant correlation with the outcome of the patient. Mortality and morbidity among diabetic patients were significant with $P < 0.001$. Other comorbidities such as hypertension and coronary artery disease do not affect the outcome of the patients significantly; Sharma *et al.*^[18] Among the 403 patients studied, 121 patients showed coagulation abnormalities, 159 showed signs of local envenomation, and 42 patients showed neurotoxicity but not all who showed coagulation abnormality developed life-threatening bleeding it was present in only nine patients; Sano-Martins *et al.*^[19] Likewise among 46 patients, those who showed some form of neurotoxicity only 28 developed respiratory failure. Other patients improved after administration of ASV and anticholinesterase. Agrawal *et al.*,^[20] the most common complication following snakebite is cellulitis and compartment syndrome (8.9%) leading to fasciotomy increases the morbidity and mortality significantly with $P < 0.0001$. The overall outcome was good, 359 patients out of 403 recovered completely without any disabilities, 33 patients developed complications and underwent some invasive procedures or recurrent blood product transfusion and discharged with some disabilities such as tracheostomy tube and raw area leg, and 11 patients were died in the hospital due to multiple complications. Even though the mortality is less compared to death of other causes, it remains the important health-related issue which could be prevented by proper health education of population and avoiding unwanted delay in seeking medical care following snakebite.

CONCLUSION

The snakebite cases account for 1.7% of all admissions in the Medicine Department in Tirunelveli Medical College and Hospital. Signs of envenomation were present in 56% of patients. About 44% of bites account for the “dry bites.” About 21% of patients developed complications following snakebite. Autonomic hyperactivity was present in 19.8% of patients. The mortality following snakebite is 11 (2.7%) among the snakebite patients.

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