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PREDICTING THE NEED FOR EARLY SURGICAL INTERVENTION IN SNAKE BITES

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INTRODUCTION:

One of the life-threatening situations we encounter in tertiary care facilities is snake bite. In India, there are over 2,000,000 snake bites reported annually. According to a study, 45,900 deaths per million people, or 5%, are primarily caused by snakebites and account for 0.5% of India's overall mortality rate1. Although medical treatment is the first line of defence against snake bites, the patient may eventually need surgery. There are numerous classifications for envenomation based on indications. Naja naja (Indian Cobra), Bungarus caeruleus (Indian Krait), Daboia russalie (Russell's viper), and Echis carinatus (Saw Scaled Viper) are the most prevalent Indian elapids. The injected venom can have a wide range of harmful effects, from local tissue damage to systemic organ failure, as shown in table 1, depending on the type of snake used. The most frequent symptoms of localised tissue injury are pain, blistering, and bruising. Compartment syndrome is caused by severe tissue necrosis. Pain, paresthesia, pallor, paralysis, poikilothermia, and pulselessness are some of the clinical signs and symptoms of compartment syndrome. A pressure more than 30 mmHg is significant of compartment syndrome, and an increase in intra compartmental pressure up to 30-45 mmHg is an unambiguous indication for fasciotomy6, according to the majority of studies on the subject. Supportive care and the administration of anti-snake-bite venom (ASV) are included

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in the treatment of poisonous snake-bite envenomation. The only specific treatment for snakebite envenomation in people for whom the advantages exceed the disadvantages is ASV.

Table 1:

Primary Affect	Effect at Cellular Level	Clinical Symptoms	Altered Laboratory Values
Hemotoxic	Metalloproteinases and other cytotoxic enzymes lyse membranes and cellular adhesions, leading to rubor, tumor, and tissue necrosis	Tachycardia, petechia, confusion, vomiting, disseminated intravascular coagulation, acute renal failure, shock and compartment syndrome	Depleted fibrin levels, anemia (intravascular hemolysis, thrombocytopenia, elevated BUN, elevated creatinine, elevated prothrombin time, elevated partial thromboplastin time
Neurotoxic	Inhibit neurotransmission signals in different ways to disrupt neurologic function. Alpha protein binds post synaptic nicotinic acetylcholine receptors. Mojave toxin irreversibly binds presynaptic nerve receptors, inhibiting the influx of calcium ions. Phospholipase A2 inhibits neuronal activity at the presynaptic terminal	Paresthesia, numbness, visual disturbance (ptosis, diplopia), dysphagia, diaphoresis, diminished reflexes, peripheral nerve palsy, respiratory depression, paralysis	Patient can have hematologic effects as mentioned in "hemotoxic" row, however, less commonly altered laboratory values and more neurological sequelae

However, there is a deficiency in proper guidelines/protocols for surgical intervention. The aim of the present study was to identify the indicators for early surgical intervention and to formulate a guideline/algorithm for surgical intervention in snake bite cases.

MATERIAL AND METHODS:

This was a prospective observational study that was conducted on patients admitted in Dr. Chandramana Dayananda Sagar Institute of Medical Education and Research. The study was conducted for a period of one year and included those patients that presented with history of snake bites. Those patients with unknown bites, cellulitis secondary to other aetiologies and those that have undergone prior surgical intervention were excluded from this study.

Method of study and collection of data:

Institutional ethical committee approval was obtained prior to the study and written informed written consent was obtained from the patients prior to recruitment to the study.

The demographic details like age, sex, site of bite: fang marks, type of snake if available, time from injury to admission, GCS, with definite history of snake bite with symptoms such as pain, pallor, paralysis, poikilothermia and diminished peripheral pulses suggestive of

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compartment syndrome of the affected limb, systemic symptoms and anti-venom dosage for both hemotoxic and neurotoxic venom was included in the present study. Based on this severity was WHO grading scale is used.

Grade	Findings	Antivenom dosage
0,No envenomation	No local or systemic signs or symptoms	No
1,Mild envenomation	Local swelling with absence of systemic sign, normal laboratory	6000 units
2,Moderate envenomation	Swelling extending past bite site (6–12 inch), ≥1 systemic sign or symptom or abnormal laboratory	6000 units
3,Severe envenomation	Snake-bites where there is marked swelling (>12 inch), tissue loss, multiple or severe systemic symptoms, immediate systemic signs, rapid progression of symptoms.	12000 units
4,Very severe envenomation	There is rapid development of local reaction, ecchymosis, necrosis, blebs, blisters, swelling severe enough to obstruct venous or arterial flow, swelling may involve ipsilateral trunk.	18000 units

For all the patients in the study, CBC, WBCT, RFT, Serum electrolytes, INR, PT, aPTT, CRP, RBS, HIV, HbsAg, HCV and Liver function test.

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Signs and symptoms will be monitored daily; complete blood counts, RFT, Serum electrolytes, INR, PT, aPTT , liver enzymes, LDH and lactate will be monitored on admission and at 48 years following admission.

Compartment pressure is monitored using Whiteside's technique.

Surgical procedures such as fasciotomy and debridement, and patients were shifted to ICU or ward depending on the overall haemodynamic stability.

The follow up will be done after 1 week of discharge, 1st month and 3rd month.

Patients received regular dressings, Vacuum assisted closure dressing or Skin grafting based on the size of the wound.

Statistical analysis:

Data will be entered into a Microsoft Excel spread sheet and subsequently it will be analysed using SPSS version 23 (SPSS Inc. Chicago, USA). Categorical variables are reported as absolute numbers and percentages. Continuous variables are described as means ± standard deviations for normally distributed data and as median values and interquartile ranges when data were not normally distributed. Descriptive statistics (means and percentages), Student t test and chi square test wherever necessary will be employed. P values of <0.05 will be considered as statistically significant.

RESULTS

The study population consisted of 50 patients with snake bites requiring surgical intervention. The average age of the study population was 39.19 years, which is consistent the working population that is usually affected by such snake bites. Majority of our study population (82%) were males, with 92% of the study participants residing in rural areas. Majority of these participants were agriculturists, forming the common population affected by venomous snake bites.

The most commonly involved body part was the left foot, especially the dorsal aspect, observed in 42% of the study population, followed by the right hand and right foot. (12% each).

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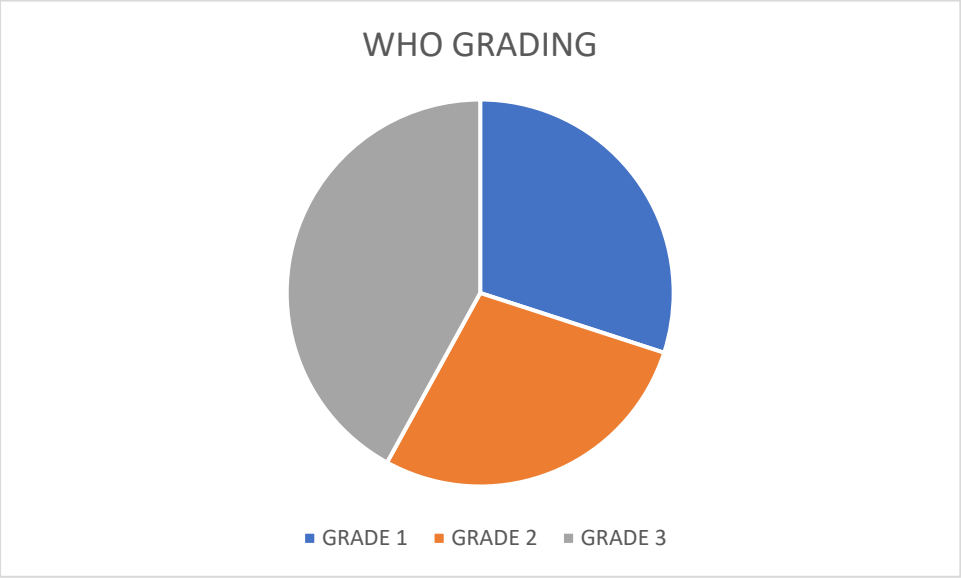
The average time to arrival to the emergency department from the incident can help predict the outcomes of such patients. In this study, it was observed that the mean time was 5.59 hours, minimum being 15 minutes and maximum being 20 hours. The Glasgow Coma Scale (GCS) was 15/5 in all patients.

On admission, the haemodynamics was monitored for every patient. We observed that the average pulse rate was 90.19 beats/ minute, with an average blood pressure of 122/72 mm Hg.

The most common WHO grading noted was grade 3 (42%) , as we observed pain and oedema of the affected body part in majority of the patients on day 1, which was progressive on day 2.

WHO grading	FREQUENCY
GRADE 1	15
GRADE 2	14
GRADE 3	21



The average compartment pressure was 30 mm Hg, which was elevated, warranting surgery.

The laboratory parameters were assessed for all patients on admission, and it is observed that haemoglobin was 13.9 on average, and there was a mean reduction of 1.21 mg/dL, which was

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significant. Similarly, the average WBC count was 10232.44 mg/dL, which showed a significant decrease from day 1 to day 2 due to IV antibiotics and ASV, but was above normal level.

Platelet counts can be significantly reduced due to the toxicity of the venom, however, we didn't observe this in the present study. Additionally, some snake venoms are also nephro- and hepatotoxic, and it this study there was a no significant increase in renal and liver parameters from day 1 to day 2.

Serum lactic acid is an indication of metabolic acidosis secondary to the venom, and it was observed to be 20.56 in our study participants.

When we correlated other laboratory markers and enzymes in snake bite, we found that there was a significant increase in LDH and LACTATE, but not AST, ALT and CRP. Hence we find that LDH and serum LACTATE can be a biomarker for severity of snake bite (The f-ratio value is 127.90823. The p-value is < .00001. The result is significant at $p < .05$)

LAB VALUES	AST	ALT	LDH	LACTATE	CRP
N	93	93	93	92	92
$\sum X$	4961	3913	28208	1891.06	470.83
Mean	53.3441	42.0753	303.3118	20.555	5.1177
$\sum X^2$	615891	227317	13205962	45064.2252	4266.6429
Std.Dev.	61.7895	26.1011	224.8222	8.2499	4.5174

WBCT was found to be more than 20 minutes in all our patients at the time of admission. After ASV and FFP when WBCT was below 20 minutes patients were taken up for surgery. The INR was found to be 1.72 seconds on an average in the study population.

The most common procedure performed in the study participants was fasciotomy performed on day 2 (48%) as there was a progression of the pain and oedema with an increase in compartment pressure. In 28% patients, no procedure was required, patients were managed conservatively with anti-oedema measures.

Patients were followed up at 1 week, 1 month and at 6 months. At the 6-month follow-up, we observed that all patients had healthy wound, following secondary suturing/SSG/ healing by secondary intention.

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DISCUSSION

There is still debate regarding when surgery is best to be performed after a deadly snakebite. If it is possible to foresee the need for surgery in such circumstances, procedures like fasciotomy, dermotomy, fasciectomy, and debridement can be carried out quickly, lowering the risks of tissue damage and comorbidity.

Patients with venomous snakebites must get systemic care, but local care must also be given. Disability may result from amputation of a finger or toe or local debridement of necrotic tissue. Patients with severe snakebites had a 25% amputation rate, according to Herzel et al. [7]. Venomous snake bites can result in mortality or amputation of a body part despite receiving the appropriate medical care, which lowers patients' quality of life.

Although there is some disagreement on the best time to intervene after a snakebite, the grounds for surgical intervention are pretty apparent. For patients with wound necrosis, abscess formation, gangrene in the digits, and necrotizing fasciitis, Mao et al. [11] have recommended surgical surgery. According to Su et al. [12], Taiwanese Naja atra envenomation patients who come with cutaneous ecchymosis or who need a high antivenom dose should be assessed to see if emergency surgery is necessary.

Snake venom is believed to act as an acute phase reactants &releasing inflammatory 2 mediators such as IL-6 and 8. IL-6 is believed to act on the liver increasing the production of acute phase reactants . The phospholipase an important component of snake venom is thought to produce haemolysis. Serum LDH levels have been found to correlate well with the severity of envenomation

In our study when we compared grade of envenomation with the acute inflammatory markers

CRP , muscle necrosis indicator Serum lactate and hemolysis factor serum LDH with raised compartment pressure . These parameters showing features of envenomation and early fasciotomy prevents spread of cellulitis.

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In our study hematological profile was also altered and it was compared with serum LDH and other acute inflammatory markers. As the haemoglobin drops which is a sign of hemolysis show significant increase serum LDH.

Level of serum LDH at the time of presentation and after 24 hours also had significant correlation with outcome of the patient which was statistically significant with the p value of less than 0.001. Serum LDH which is a marker of hemolysis which is worst prognosis in the outcome of the victims were correlated. A study4 done on Sholapur on 30 snake bites reorted elevated serum LDH in all the patients. The LDH levels correlated well to the severity of hemolysis compared to normal levels in the control group. A prospective study5 from Brazil among children with moderate to severe snake bite envenomation showed early and persistent rise in serum LDH levels upto 48 hours which correlated well with degree of hemotoxicity of snake bite.

Bleeding time, clotting time and a 20 minute whole blood clotting test will be repeated 6th hourly for first 24hrs of the hospital admission.

In a study by Matthew C. Hernandez et al 2 conducted a single institutional review for children undergoing fasciotomy, it was linked with factors such as haemoglobin 11 mg/dL, leukocytosis, INR >1.2, presentation >24 h after snake bite, and age-adjusted shock index.

According to age and sex, in the present study, majority of the middle aged males required surgical intervention. Chethan P. R. et al. 3 conducted a study at KIMS Hubli from January 2013 to December 2013 on the frequency of snakebite cellulitis. Cellulitis was graded, and fasciotomies were performed for complications like compartment syndrome and necrotizing fasciitis.

Elevated WBC and AST, which are related to surgical treatment, were found to be associated with the development of post-snakebite compartment syndrome in snakebite patients by Chih-Po Hsu et al 5. However, we did not find the similar association, with both are elevated above normal.

Early fasciotomy, was carried out in the treatment of snake bites in the absence of the traditional compartment syndrome criteria. In our study, we performed the majority of the

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fasciotomies on day 1 of admission. In a study by Firath et al.9, similar findings were observed, and they concluded that it expedites clinical recovery and lessens progressive tissue damage

Conclusion

Snake bite cellulitis is a rare and unfortunate occurrence, adding to the debility, mental stress and cost of a patient suffering. Here we present the approach to diagnosis and management of such a dreaded complication, with good outcome in most patients.

We recommend early fasciotomy to prevent compartment syndrome, to prevent limb loss.

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