**Research Article**

**Grading and Envenomation of the Snake Bite among the Emergency Cases in a Medical College in Rural India**

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**Abstract:** Bites in which the fangs pierce the skin but no envenoming results are known as “dry bites”. Venomous snakebite can cause rapid and irreversible complications like shock, systemic bleeding, respiratory muscle paralysis, acute renal failure and necrosis of tissue at the site of the bite. This observational study was conducted at IGMC, Shimla over a period of one year among children up to 18 years of age with history of snake bite as confirmed by themselves or by a reliable witness admitted to the Pediatrics department. Most of the symptomatic patients were cases of hemotoxic envenomation as compared to neuroparalytic envenomation. 20% cases were graded as Grade 0, 13.3% were classified as Grade 1, 26.7% were classified as Grade 2, 23.3% were classified as Grade 3 and 16.7% were graded as Grade 4. Grading being a subjective process is not very good indicator of degree of envenomation and further prognosis. Hence, grading of envenomation may not be encouraged. Most of the symptomatic patients were cases of hemotoxic envenomation as compared to neuroparalytic envenomation. Twenty-minute whole blood clotting test (20WBCT), considered as a reliable test for coagulopathy.

**Keywords:** envenoming results, “dry bites”, systemic bleeding.

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**INTRODUCTION**

Snake bite is generally considered a rural problem and is often linked with environmental and occupational condition. The risk of envenoming after venomous snakes bites varies with species but is on an average only about 50% (Theakston, R. D. G. *et al.*, 2003). Bites in which the fangs pierce the skin but no envenoming results are known as “dry bites”. Venomous snakebite can cause rapid and irreversible complications like shock, systemic bleeding, respiratory muscle paralysis, acute renal failure and necrosis of tissue at the site of the bite. The toxic component of snake venom can be classified into four broad categories: enzymes, polypeptides, glycoproteins, and compounds of low molecular weight (Ahmed, S. M. *et al.*, 2008). They can also be classified as protein (90–95%) and nonprotein (5–10%) compounds.

Clinic-toxicologically, snake envenomation is categorized as hemotoxic, neurotoxic and myotoxic. According to Wheeless’ Textbook of Orthopaedics, snake envenomation is divided into four grades.

**Grade 0:** No envenoming, fang marks present and minimal pain.

**Grade I:** Minimal envenomation, fang marks present, pain, 1 to 5 inches of edema and erythema in 1st 5 hours; no systemic symptoms.

**Grade II:** Moderate envenomation, fang marks present, pain, 6-12 inches of edema in first 12 hours; systemic symptoms may be present along with rapid progression of signs from grade I and may have bleeding from bite site.

**Grade III:** Severe envenomation, fang marks present, pain, edema greater than 12 inches in first 12 hours; systemic symptoms, including coagulation defects; signs of grade I and II envenomation appear in rapid progression.

**Grade IV:** Very severe envenomation, local reaction develops rapidly. Edema may involve ipsilateral trunk. Possess high potential for compartment syndrome.

Severe local symptoms are defined as swelling rapidly crossing a joint or involving half of the bitten limb, in the absence of a tourniquet. For the early and proper management of snake bite, knowing the type and extent of the envenomation is an important step. So, this study was conducted to see the type and grading of envenomation among children from age group of 0-18 years admitted for snake bite to Department of Pediatrics, IGMC.
METHODOLOGY

This observational study was conducted at IGMC, Shimla over a period of one year among children up to 18 years of age with history of snake bite as confirmed by themselves or by a reliable witness admitted to the Pediatrics department. Vitals including arterial oxygen saturation/ PR/BP/SPO2/RR / Blood pressure and ABG, if required was assessed in all patients. After assessment of systemic envenomation, symptomatic treatment was started in all patients along with antibiotics and adequate hydration. All snake bite patients were investigated with 20-minute whole blood clotting time, complete blood count, coagulation tests, electrolytes and urine for hematuria for determination of type of envenomation. The 20-min whole blood clotting test (20 WBCT) was done at patient’s bed side in a clean sterile tube/vial. Thereafter, demographic characteristics, history and details of envenomation and referral history, if any were recorded in pre-designed proforma (PDP). Thorough clinical examination was done and grades with reference to envenomation were given and recorded in PDP.

Ethical Considerations - Approval for the study was obtained from the Hospital Ethics Committee. All parents were explained briefly regarding methodology of study. Participants were informed about the study in their own language before obtaining written consent.

Statistical Analysis - Data collected was entered and analyzed using Epi Info (Version 7.2.2.6). Data was expressed in its frequency and percentage. Data analysis was done by necessary descriptive and inferential statistics. Appropriate descriptive statistical technique like mean, median, mode, percentile and standard deviation was used for data analysis and analyzed data was presented in form of tables, diagram and graphs based on findings.

RESULTS

Depending upon the development of various clinical features, the type of snake was divided into venomous and non-venomous. Non venomous bite does not showed any marked clinical features but the snake was spotted physically by victim/guardian. Generally pain was present at bite site but no swelling or edema was noticed. Venomous snake bite showed severe local symptoms (swelling rapidly crossing a joint or involving half of the bitten limb, in the absence of a tourniquet), systemic symptoms and coagulation defects. There were various modes of presentation of patients suggestive of either hemotoxic or neurotoxic nature of the snake. The bites have any of the following manifestations – whole blood clotting time (WBCT) of more than 20 min, haematuria, epistaxis, hypotension, ecchymosis, subconjunctival bleed, haematemesis or encephalopathy were classified as haemotoxic bites. Those bites having ptosis, diplopia, convulsions, dysphagia or inability to speak were classified as neurotoxic bites.

As per the parents/guardians description, most snake bites were suggestive of venomous snakes bite (green colored snakes could be pit viper/bamboo pit viper, black colored may be krait or cobra). 70% of the bites were hemotoxic, 20% were dry bites and 10% were neuroparalytic type. Some patients also showed marked local reaction at site of bite, hence the bites were further categorized as mentioned in Table 1.

Table-1: Type of Envenomation

<table>
<thead>
<tr>
<th>Type of Envenomation</th>
<th>Male</th>
<th>female</th>
<th>Total</th>
<th>% age</th>
</tr>
</thead>
<tbody>
<tr>
<td>No envenomation</td>
<td>2</td>
<td>4</td>
<td>6</td>
<td>20</td>
</tr>
<tr>
<td>Hemotoxic</td>
<td>4</td>
<td>1</td>
<td>5</td>
<td>16.7</td>
</tr>
<tr>
<td>Neurotoxic</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>6.7</td>
</tr>
<tr>
<td>Hemotoxic &amp; Local</td>
<td>10</td>
<td>6</td>
<td>16</td>
<td>53.4</td>
</tr>
<tr>
<td>Neurotoxic &amp; Local</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>3.3</td>
</tr>
</tbody>
</table>

The ratio of vasculotoxic to neuroparalytic snake bite in male patients was 14:1 and in female patients was 7:2. 10% (n=3) patients were admitted unconscious while rest 90% (n=27) were calm, conscious, alert and in good physical condition. None of the patients were febrile on admission.

Most of the patients 73.33% (n=22) admitted at IGMC, Shimla were referral cases, presented with either bite history or some features of envenomation. Among these, two cases each were of non poisonous bite and neuroparalytic envenomation while rest 81.81% (n=18) were of hemotoxic envenomation. Among all the 30 cases admitted at IGMC, Shimla 20% cases observed were non poisonous bites, 6.66% were neurotoxic only, 16.7% were hemotoxic only, 3.3% were neurotoxic and local while 53.4% were hemotoxic and local envenomation.

Among the thirty patients, 20% of the patients were asymptomatic and the rest 80% patients showed various signs of envenomation. The most common clinical manifestation was local pain (83.3%) followed by edema/swelling (70%). In hemotoxic snake bites, local edema was mostly present in all patients but cellulitis/ulceration and bite site gangrene was also observed in one-one patient. 38.1% (8/21) patients had vomiting as constitutional symptoms. 20WBCT was positive for 15 patients (50%).
Depending upon the severity and rapidity of development of clinical signs and symptoms, the envenomation were given four grades i.e. Grade 1, Grade 2, Grade 3 and Grade 4 (Table 2). All dry bite cases (20%) were classified as Grade 0. All cases of neuroparalytic envenomation (10%) were classified as Grade 4. Among the (70%) hemotoxic envenomation cases, 19.1% (n=4) were classified as Grade 1, 38.1% (n=8) were classified as Grade 2 (mild), 33.4% (n=7) were classified as Grade 3 and 9.5% (n=2) were classified as Grade 4 (severe envenomation).

**Table 2 Grading: Snake bite envenomation patients**

<table>
<thead>
<tr>
<th>Grades</th>
<th>Grade 0</th>
<th>Grade 1</th>
<th>Grade 2</th>
<th>Grade 3</th>
<th>Grade 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>N (%)</td>
<td>N (%)</td>
<td>N (%)</td>
<td>N (%)</td>
<td>N (%)</td>
</tr>
<tr>
<td>Hemotoxic</td>
<td>6</td>
<td>4</td>
<td>19.1</td>
<td>8</td>
<td>38.1</td>
</tr>
<tr>
<td>Neurotoxic</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Total</td>
<td>6</td>
<td>4</td>
<td>8</td>
<td>7</td>
<td>5</td>
</tr>
</tbody>
</table>

**DISCUSSION**

Majority of the snakebite cases in the hills of Himachal Pradesh are due to either non-venomous snakes or “dry bites” of venomous snakes (Raina, S. et al., 2014). In this study, only 6 cases of non venomous bites were recorded. This less number may be attributed to the fact that being a tertiary institution, cases with complications arising out of hemotoxic/neurotoxic bites or severe systemic envenomation were referred to IGMC and probably non venomous bites were managed at primary or secondary institution. In this study, most of the symptomatic patients were cases of hemotoxic envenomation (87.5%) as compared to neuroparalytic envenomation (12.5%). This was in concordance with study conducted by Gupta et al., in which hemotoxic envenomation was reported more than neurotoxic envenomation (Saikia, U. et al., 2007). Another reason for reporting of fewer neurotoxic bites in our study could be due to the low prevalence of neurotoxic snakes in surrounding area of Shimla. Saikia et al., has studied the herpetofauna of Himachal Pradesh in details and reported abundant presence of Trimeresurus albolabris (White-lipped pit viper) and Gloydius himalayanus (Himalayan Pit Viper) from Solan, Shimla, Mandi districts of Himachal Pradesh. But other studies from other regions of Himachal Pradesh show a prevalence of NE over HE (Jamieson, R., & Pearn, J. 1989). Hence, further studies including large number of subjects are needed to explore it.

Most of the children following venomous snake bite develop variable local or systemic symptoms. Within a single species, the toxicity of the venom can vary according to the season, geographical area, snake’s physical characteristics, and according to length of time since last strike. Hemotoxic bites mostly result into local edema, cellulitis, gangrene and bleeding from bite site. In our study, local edema/swelling was the most common (80.9%) (n=17) clinical feature seen in all patients of hemotoxic snake bites and cellulitis/gangrene was seen in only one patient(4.8%). T. albolabris (white lipped pit viper), G. himalayanus (himalayan pit viper) bites are known notoriously for marked localized signs in the form of pain, marked swelling, bruising and bleeding and hence it may be attributed to one of the cause (Tekin, R. et al., 2015). Local swelling was observed in only case of neurotoxic bite and rest two cases does not caused any local signs. Pauvicy or absence of local pain and swelling is attributes to krait bite. Out of the 3 cases presented with neuroparalytic syndrome, only one case was presented with early morning neuroparalytic syndrome. These rare syndromes are caused by krait bites. The kraits often enter the houses in search of food especially during midnight to early morning. When disturbed accidently during sleeping, they bite painlessly. Hence, in such cases absence of bite mark/faint bite marks with no specific history of snake bite delay the treatment of envenomation thus making treatment and management more complex.

All the symptomatic envenomation patients were graded into four grades, according to severity and rapidity of development of clinical signs and symptoms i.e. Grade 1, Grade 2, Grade 3 and Grade 4. All cases of neuroparalytic envenomation (10%) were classified as Grade 4. Among the (70%) hemotoxic envenomation cases, 38.1% were classified as Grade 2, 33.4% were classified as Grade 3 and 9.5% were classified as Grade 4. Grading of envenomation by assessment of severity of bite is a subjective process and hence is dependent on the individual observation. Hence, it is not very good indicator of degree of envenomation and further prognosis. Also, the degree of severity of a bite may rapidly progress from one degree to the next during treatment (Chugh, K. S. 1989).

Most of the venomous bites (70%) in our study were hemotoxic. In our study hemotoxic snake bite caused hematuria (4.8%) and epistaxis (4.8%) in one-one patient. Proteinuria was also observed in 19.04% patients. Acute kidney injury was observed in one patient who required hemodialysis. One patient with hemotoxic envenomation also required blood transfusion while Fresh frozen plasma (FFP) was given in (20.8%) five cases. One patient with respiratory distress required oxygen by nasal prongs only. Hematologic abnormalities occur commonly after pit viper envenomation. It is observed that saw-scaled vipers do not cause renal failure where as Russell’s viper and hump-nosed pit viper do. In India, the
incidence of acute renal failure is 13-32% following viper bite (Chugh, K. S. (1989 et al., 2013). It is observed that Russell’s viper sometimes can also manifest neurotoxic symptoms which can cause confusion in diagnosis. The neurotoxic symptoms in Russell’s viper are believed to be due to presence of a presynaptic toxin like that in common Krait.

**CONCLUSION**

Most of the symptomatic patients were cases of hemotoxic envenomation as compared to neuroparalytic envenomation. Grading being a subjective process is not very good indicator of degree of envenomation and further prognosis. Hence, grading of envenomation may not be encouraged. Most of the symptomatic patients were cases of hemotoxic envenomation as compared to neuroparalytic envenomation. Twenty-minute whole blood clotting test (20WBCT), considered as a reliable test for coagulopathy.

**REFERENCES**