



## CHAPTER IV

# MEASUREMENT

Manifestations of *C. rhodostoma* and *N. kaouthia* envenomations in human beings vary widely. Adverse effects range from puncture wounds without apparent clinical symptom ( “ the dry bite”) to life – threatening effects including coagulopathy, increased vascular permeability, and neurological manifestations. Most patients exhibit only a subset of possible consequences. However, because of variability in the victim’s response to venom and in the venom itself, which varies from species to species and from season to season, all, some, or none of the anticipated manifestations of snake venoms poisoning may develop in a given patient (Russell, 1983).

### 1. Measurement assessments

Among victims who have symptoms, the duration between the onset of bite and onset of symptoms varies. Venom effects may begin within minutes or be delayed for hours. This unpredictable nature of snakebite makes assessment and management difficult. The literature is difficult to interpret because investigators use different methods of evaluation (Russell, 1983; Van Mierop, 1976). Two classification methods for evaluating of snakebite have been widely disseminated (Tables 4 and 5 ).

**Table 4.** The classification for evaluating snakebite by Russell (1983).

<b>Minimal – moderate – severe scoring method</b>	
• Minimal envenomation	Local swelling and other local changes ; no systemic manifestation ; normal laboratory findings
• Moderate envenomation	Swelling progressive beyond the site of bite and one or more systemic manifestations ( eg, abnormal laboratory findings such as decrease hematocrit or platelets).
• Severe envenomation	Marked local response, severe systemic manifestations, and significant alteration in laboratory findings

Table 5. The classification for evaluating snakebite by Van Mierop ( 1976).

<b>Grade I – IV scoring method</b>	
• 0	No envenomation : fang marks and minimal pain
• I	Minimal envenomation : fang marks, pain, 1 to 5 inches of edema and erythema during the first 12 hours; no systemic symptom.
• II	Moderate envenomation : fang marks, pain, 6 to 12 inches of edema, and erythema in the first 12 hours; systemic symptoms may be present, along with rapid progressive of signs from grade I; blood ooze at bite site.
• III	Severe envenomation : fang marks, pain, edema greater than 12 inches in first 12 hours; systemic symptoms, including coagulation defects after pit viper bites; signs of grades I and II appear in rapid progression, with immediate systemic signs and symptoms.
• IV	Very severe envenomation : local reaction develops rapidly, edema may involve ipsilateral trunk; ecchymoses, necrosis , and blebs and blisters develops; at tightly restrictive fascial planes, tension may become great enough to obstruct venous or even arterial flow

Although both methods have been used for many years, they lack specificity in grading the severity of tissue necrosis. Snakebites are categorized into only three or four classes. In addition, both methods are subjective and therefore not suitable for use in assessment. Some patients cannot be classified according to these systems. For

example, a patient with a finger bite and swelling to elbow after 4 hours but no coagulopathy or systemic effects would fall between categories of moderate and severe in one system and between grade II and III in the other. Thus, an investigator could categorize the patient in two different ways, making these tools imprecise. In addition, neither system has been validated as a clinical or research tool. Thus no proven instrument exists for the research evaluation of *N. kaouthia* and *C. rhodostoma* bites.

For this study of *C. rhodostoma* and *N. kaouthia* envenomation, we focused on symptoms on presentation and determined whether there was progression i.e., worsening of clinical signs and symptoms over time. Three organ systems were used to determine the degree of envenomation on presentation. The scoring method was developed by Dart et al (1996) and has been tested for reliability and validity.

This scoring was used in a retrospective study to quantify the severity of envenomation in 108 patients. Physical and laboratory parameters were selected for our data base by discussion with physicians experienced in the treatment of snakebite and by review of literature, textbooks in emergency medicine and medical toxicology (Dart, et al., 1996).

Calculation of the SSS involves the evaluation of six areas that experienced clinicians use in the evaluation of snakebites (Table 6). The SSS range of severity is 0 to 3 or 0 to 4 for each area of evaluation; a higher score indicates more severe effects. The score total ranges from 0 to 20 points.

**Table 6.** SSS evaluation

<b>Criteria</b>	<b>Points</b>
<b>Pulmonary system</b>	
<input type="checkbox"/> No symptom / sign	0
<input type="checkbox"/> Dyspnea , minimal chest tightness , mild or vague discomfort or respiration of 20 to 25 /min	1
<input type="checkbox"/> Moderate respiratory distress (tachypnea, 26 to 40 breaths per min ; access muscle use)	2
<input type="checkbox"/> Cyanosis, air hunger, extreme tachypnea, or respiratory insufficiency/ failure	3
<b>Criteria</b>	
<b>Points</b>	
<b>Cardiovascular system</b>	
<input type="checkbox"/> No symptom / sign	0
<input type="checkbox"/> Tachycardia (100 to 125 beats per min) , palpitations, generalized weakness , begin dysrhythmia, or hypertension.	1
<input type="checkbox"/> Tachycardia (126 to 175 beats per min), or hypotension, with systolic blood pressure > 100 mmHg	2
<input type="checkbox"/> Tachycardia ( >175 beats per min ), or hypotension, with systolic blood pressure < 100 mmHg, malignant dysrhythmia , or cardiac arrest	3

Criteria	Points
<b>Gastrointestinal system</b>	
<input type="checkbox"/> No symptom / sign	0
<input type="checkbox"/> Pain , tenesmus, or nausea	1
<input type="checkbox"/> Vomiting and diarrhea	2
<input type="checkbox"/> Repeated vomiting, diarrhea , hematemesis , or hematochezia	3

Criteria	Points
<b>Central nervous system</b>	
<input type="checkbox"/> No symptom / sign	0
<input type="checkbox"/> Minimal apprehension, headache, weakness, dizziness, chills , or paresthesia	1
<input type="checkbox"/> Moderate apprehension, headache, weakness, dizziness, chills , paresthesia , confusion , or fasciculation in area of bite site	2
<input type="checkbox"/> Severe confusion, lethargy, seizures, coma, psychosis , or generalized fasciculation	3

Criteria	Points
<b>Hematological signs</b>	
<input type="checkbox"/> No symptom / sign	0
<input type="checkbox"/> Coagulation parameters slightly abnormal : PT < 20 s ; PTT < 50 s ; platelet 100, 000 – 150,000/ml ; or fibrinogen 100 – 150 ug/ml	1
<input type="checkbox"/> Coagulation parameters abnormal : PT 20 to 50 s ; PTT < 50 to 75 s ; platelet 50, 000 – 100,000/ml ; or fibrinogen 50 – 100 ug/ml	2
<input type="checkbox"/> Coagulation parameters abnormal : PT 50 to 100s ; PTT 75 to 100s ; platelet 20, 000 – 50,000/ml ; or fibrinogen < 50 ug/ml	3
<input type="checkbox"/> Coagulation parameters marked abnormal with serious bleeding or the threat of spontaneous bleeding : unmeasurable PT or PTT ; platelet < 20, 000/ml ; or fibrinogen severe abnormalities of other laboratory values also fall into this category.	4

Criteria	Points
<b>Local wound</b>	
<input type="checkbox"/> No symptom / sign	0
<input type="checkbox"/> Pain, swelling , or ecchymosis within 5- 7.50 cm of bite site	1
<input type="checkbox"/> Pain, swelling , or ecchymosis involving less than half the extremity (7.50 – 50 cm from bite site )	2
<input type="checkbox"/> Pain, swelling, or ecchymosis extending beyond affected extremity (> 100 cm from bite site)	3

## **2. The assessment of clinical snake envenomation and tissue necrosis.**

The scoring method described above will be used as the main instrument to assess clinical snake envenomation. The definition of each clinical manifestation in each organ system within the SSS will be explained to the local investigators. These were nurses who were members of the research team in each hospital. These nurses will make sure that physicians who look after snakebite victims search for and record all the clinical symptoms on the patient chart. The presence or absence of clinical manifestations will be abstracted by two other nurses in a blind and independent fashion. They placed the information on a data form. The contact person collected all the record forms and ensure their completeness. These forms were sent to the researcher who analyzed the information for consistency. The researcher will make a final decision by reviewing the patient chart if there is an inconsistency between the two abstractions.

The degree of envenomation will be determined for each patient by adding up the scores from the clinical manifestations in each system. Patients will be classified from no envenomation to severe envenomation according to the following criteria: none = score 0-2, minimal = score 3-5, moderate = score 6-8, severe = score 9-20.

Clinical manifestations of the local wounds will be used to classify the severity of tissue necrosis according to the following: none = score 0 (no symptom/sign), minimal = score 1 (pain, swelling, or echymosis within 5-7.5 cm of bite site), moderate = score 2 (pain, swelling, or echymosis involving less than half the extremity; 7.5-50 cm from bite site), severe = score 3 (pain, swelling, or echymosis extending beyond



affected extremity; > 100 cm from bite). Tissue necrosis will be considered if the victims has minimal, moderate or severe tissue necrosis.

### **3. Sensitivity and specificity.**

3.1. *Sensitivity* is the proportion of truly diseased persons, as measured by the gold standard, who are identified as diseased by the test under study (Colton, 1991).

3.2. *Specificity* means the proportion of truly nondiseased persons, as measured by the gold standard, who are so identified by the diagnostic test under study (Colton, 1991).

In the original SSS (1996) , sensitivity and specificity of a change in the SSS in the detection of clinically significant worsening (as assessed on the basis of the physicians' consensus) were also calculated. The sensitivity of a change in the SSS of 1 point in detecting clinically significant worsening of the envenomation syndrome was 0.97 ; the specificity, 0.81. All components correlated highly with the total SSS with correlation ranging from +0.51 to +0.71. Thus when more of the component scores (clinical manifestations) were included, all component scores correlated highly with the total SSS and the instrument has a high sensitivity and specificity in assessing clinical snake envenomation. The applicability of SSS in assessment of clinical snake envenomation and severity of tissue necrosis is being carried out.

#### 4. Validity

Validity is the quality of a questionnaire, surveys, or any other research measurement tool. It expresses the degree to which the tool measures what it purports to measure are true.

- The content validity is the extent to which the content of the instrument appears to logically examine and include the characteristic it is intended to measure.

The original SSS questionnaire (1996) will be translated into Thai. The medical terms will be discussed with physician experts for a clear understanding of meaning before using the SSS in a pilot study.

In the experimental design (1996), each medical record was evaluated independently and the SSS calculated with the use of a standardized abstract form by a single research assistant blinded to the physician's assessment. Each chart was independently and blindly reviewed by two physicians experienced in the management of snake envenomation. In this evaluation, all components correlated highly with the total SSS, with correlation ranging from +0.51 to 0.70. Thus none of the component scores were redundant, and all component scores correlated with the total SSS. Thus, the evaluation should be appropriated to in classifying the degree of severity before administers antivenoms or other treatment.

## 5. Reliability

Reliability refers to the reproducibility and consistency of the instrument, and the degree to which it is free from random error. There are several criteria that should be assessed before an instrument can be judged reliable. These include test-retest, inter-rater reliability and internal consistency (Stein, 1989).

5.1. *Test-retest* is the measure in which the instrument is administered to the same population on at least two occasions and the results are found to correlate. Statistics were used depending on scale as well as Pearson or Spearman rank correlation. Pearson (r) correlation assess that two variables are measured on at least interval scales and Spearman rank (R) correlation is sensitive only the ordinal arrangement of values

5.2. *Inter-rater reliability* is the extent to which results obtained by two or more raters agree for the same population. The calculation, if scale scores are quantitative using Cronbach's alpha or if scale scores, are nominal using Kappa.

5.3. *Internal consistency* is the concordance between two variables that measure the same general characteristic. The method testing internal consistency, Cronbach's alpha, is an estimate of internal consistency based on all possible correlation between all the items within the scale.

After testing SSS scales in a pilot study, the data from two investigators will be evaluated for internal consistency, inter-rater reliability of correlation by using Cronbach's alpha.

The snakebite severity score (SSS)(1996) is used by the two physicians experienced in the management of snake envenomation. The evaluation was performed

by multiple-regression analysis to evaluate the relative contribution of each component to the total SSS and to determine whether the various components correlated highly with each other and were therefore redundant or, alternatively, contributed very little to the total SSS. The correlation between the physicians' assessment of severity and the SSS at the time of presentation was highly statistically significant ( $r = + 0.63$ ,  $z$  score = 6.52,  $p < 0.000001$ ). The correlation of the same parameters for the worst condition was also highly statistically significant ( $r = +0.70$ ,  $z$  score = 7.24,  $p < 0.000001$ ).

Reliability will be tested again after completion of the experiments of the prospective and retrospective studies by using Cronbach's alpha.

## **6. Credibility**

The correlation between SSS and the physicians' assessment at baseline and at the point of patient's worst condition was highly statistically significant, indicating that the score increased in proportion to the patient's condition at baseline or worst condition. A scoring system that reliably detects worsening would permit meaningful comparisons among different treatment methods.

## **7. Bias**

Bias should be minimized because physicians performed independently by blinded assessment. The inclusion and exclusion criteria are clearly identified for screening victims.

Finally, The snakebite severity score (SSS) is a recently published research tool and is expected to be used under clinical research conditions. Its interrater reliability,

and its effect on clinical decision making have been tested. The SSS score method will be appropriate for assessing the degree of clinical snake envenomation and tissue necrosis in *C. rhodostoma* and *N. kaouthia* bites victims who had different signs/symptoms (hematological and neurotoxic complication). It covered every human system including pulmonary, cardiovascular, gastrointestinal, hematological, central nervous systems and local reactions. Therefore, this tool will be appropriate to be used in snakebites patients for determining severity of clinical syndromes. It will be the best tool for doctors to use to classify signs and symptoms before administration of antivenom.

### **8. Classification level of treatments**

The severity of tissue necrosis is divided into various levels and into the needed to use surgical treatment at different levels (Toma, 1999).

- *Dressing*. It is the material applied to a wound for the protection of the wound and absorbance of drainage.
- *Debridement*. It means removal of foreign material and devitalized or contaminated tissue from / or adjacent to a lesion until healthy tissue is exposed. Various methods can be used and in some cases skin grafts will be used.
  - *Skin graft*. A procedure that moves a segment of dermis and a portion of epidermis. The graft is completely separated from its blood supply and donor site and moved to a recipient site. Skin grafts contain varying portions of epidermis and dermis

and can be full thickness or partial thickness, depending upon how much dermis is included in the graft. One disadvantage of skin grafts applied to granulating bone is that there is no padding and the graft usually does not survive.

- *Amputation* is loss or absence of all or part of a limb.