SNAKE BITE ENVENOMATION AND ANTI SNAKE VENOM – A DESCRIPTIVE STUDY

Dissertation submitted for

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CERTIFICATE

This is to certify that this dissertation titled **"SNAKE BITE ENVENOMATION AND ANTI SNAKE VENOM – A DESCRIPTIVE STUDY"** submitted by **DR. M. RAJKUMAR** to the faculty of General Medicine, The Tamil Nadu Dr. M.G.R. Medical University, Chennai in partial fulfillment of the requirement for the award of MD degree Branch I (General Medicine) is a bonafide research work carried out by him under our direct supervision and guidance.

Dr P. Selvaraj MD
Professor of Medicine
Chief IV Medical unit
Department of Medicine
Madurai Medical College
Madurai.

Dr. Nalini Ganesh MD
Professor and Head
Department of Medicine
Madurai Medical College
Madurai.

DECLARATION

I, **Dr. M.Rajkumar**, solemnly declare that the dissertation titled **"SNAKE BITE ENVENOMATION AND ANTI SNAKE VENOM – A DESCRIPTIVE STUDY"** has been prepared by me.

This is submitted to the Tamil Nadu, Dr. M.G.R. Medical University Chennai, in partial fulfillment of the regulations for the award of MD degree Branch I (General Medicine).

Place : Madurai **Dr. M.RAJKUMAR**

Date :

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CONTENTS

INTRODUCTION

Snake bite is an occupational hazard of farmers, plantation workers and others, resulting in tens of thousands of deaths each year. Approximately 15% of the **3000 species of snakes found worldwide** are considered to be dangerous to humans. There are about **216 species of snakes identifiable in India**, of which **52 are known poisonous**.

The major families of snakes in India are ***Elapidae*** which includes common cobra *(Naja naja)*, king cobra and common krait *(Bungarus caerulus)*, ***Viperidae*** includes Russell's viper, saw scaled viper *(Echis carinatus)* and pit viper and ***Hydrophidae*** (the sea snakes).

More than **2,00,000 snakebites** are reported in the country annually and it is estimated that between **35000 and 50,000 people die of snakebite each year in India**. Deaths typically occur in children, in the elderly, and in victims to whom antivenom is not given, is given after a delay, or is administered in insufficient quantities. Typically, victims are male and between 17 and 27 years of age. 98% of bites are on extremities, most often the hands or arms, and result from deliberate attempts to handle, harm, or kill the snake. Most bites occur between April and September, when snakes are active and humans are outdoors.

ASV is most prestigious and valued, its preparation involves catching or parking snakes, milking of snakes at laboratory, immunizing horses with venom. Hence ASV should be used only in an indicated case in proper doses to prevent crisis of its supply. In India polyvalent ASV is available which contains antibody against cobra, Russell's viper, common krait and saw-scaled viper. Many times it is administered in nonindicated cases.

Total dose of Anti Snake Venom

The empirical total doses of ASV used in various centers in India are as follows (JAPI Vol 52 JAN 2004, Snake Venoms & Antivenoms: Critical Supply Issues, HS Bawaskar):

1. **For Russell's Viper : 100 – 800 ml**
2. **For Saw Scaled Viper : 20 – 450 ml**
3. **For Krait : 50 – 360 ml**
4. **For Cobra : 50 – 360 ml**

ASV neutralizes the circulating venom only and no amount of ASV will neutralize or combine with venom once the venom is attached or adsorbed to target organs i.e. platelets, RBCs, vascular endothelium, renal tubules, muscles and neuromuscular receptors. Early administration of ASV prevents the target organ damage. Half-life of ASV varies 26- 96 hours, whereas antigen (venom) may reappear in circulation as long as 130 hours.

Five lakh ASV vials are manufactured by the four institutes (**Haffkine Institute**, Mumbai, **Serum institute**, Pune, **King Institute**, Chennai & **Central Research Institute**, Kasauli). Exact total amount of venom injected by snake at the time of bite is unknown. However, the clinical features and outcomes are not as simple as predicted, because every bite does not result in complete envenomation.

Features of Venom and Antivenom

The approximate fatal doses of venom of the poisonous snakes are as follows:

1. **For Russell's Viper : 150 mg**
2. **For Cobra : 120 mg**
3. **For Saw scaled Viper : 80 mg**
4. **For Krait : 60 mg**

The approximate quantity of venom neutralised by 1ml of Polyvalent ASV is given below:

1. **For Russell`s Viper : 0.60 mg**
2. **For Cobra : 0.60 mg**
3. **For Saw Scaled Viper : 0.45 mg**
4. **For Krait : 0.45 mg**

However, ASV is the cornerstone in management of snakebite, even though the optimal dose, frequency and mode of administration and duration of therapy remain unclear. There are only a few trials from India, which address these questions. Accurate optimization of therapy may lead to a reduction in the dose. Though the use of anti-snake venom (ASV) has been in existence for many years, there is no universally accepted standard regarding the optimum dose of ASV, its frequency of administration and duration of therapy.

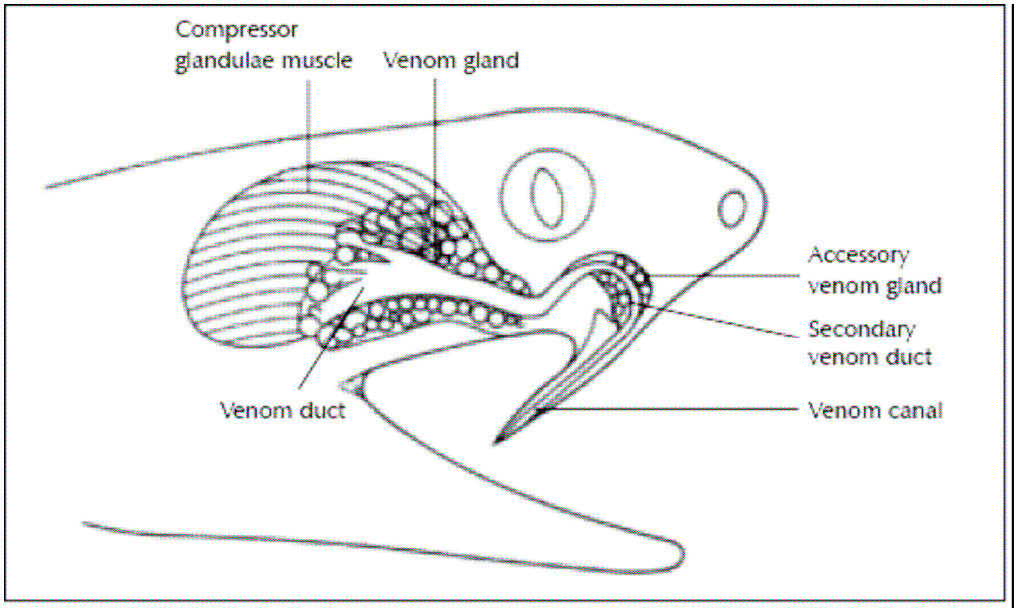
Keeping all the above-mentioned issues in mind, this study was conducted to evaluate the optimal dose and use of ASV in In-patients admitted in IV Medical unit, Department of Medicine in Govt Rajaji Hospital, Madurai.

REVIEW OF LITERATURE

VENOMOUS SNAKES OF SOUTH-EAST ASIA

THE VENOM APPARATUS

Venomous snakes of medical importance have a pair of enlarged teeth, **the fangs**, at the front of their upper jaw. These fangs contain a venom channel (like a hypodermic needle) or groove, along which venom can be introduced deep into the tissues of their natural prey. If a human is bitten, venom is usually injected subcutaneously or intramuscularly.



Venom apparatus of a saw-scaled viper

Classification

There are 2 important groups (families) of venomous snakes in South-East Asia.

Elapidae have short permanently erect fangs. This family includes the cobras, king cobra, kraits, coral snakes and the sea snakes. The most important species, from a medical point of view, include the following:

Cobra

Cobras:	N naja	Common Spectacled Indian cobra
(Genus Naja)	N oxiana	North Indian or Oxus cobra
	N kaouthia	Monocellate cobra
	N philippinensis	Philippine cobra
	N atra	Chinese cobra
Spitting cobras:	N siamensis	
	N sumatrana	
	N sputatrix	
King cobra:	Ophiophagus hannah	

Kraits:	B caeruleus	Common krait
(Genus Bungarus)	B candidus	Malayan krait
	B multicinctus	Chinese krait
	B fasciatus	Banded krait

Sea snakes: important genera include Enhydrina, Lapemis & Hydrophis

Viperidae have long fangs, which are normally folded up against the upper jaw but, when the snake strikes, are erected. There are two subgroups, the **typical Vipers (Viperinae) and the Pit vipers (Crotalinae)**. The Crotalinae have a special sense organ, the pit organ, to detect their warm-blooded prey. This is situated between the nostril and the eye. Medically important species in South-East Asia are:

Typical vipers:	Daboia russelii	Russell's vipers
	Echis carinatus	Saw-scaled or carpet vipers
	E sochureki	
Pit vipers:	Calloselasma rhodostoma	Malayan pit viper
	Hypnale hypnale	hump-nosed viper

Green pit vipers or bamboo vipers: (genus Trimeresurus)

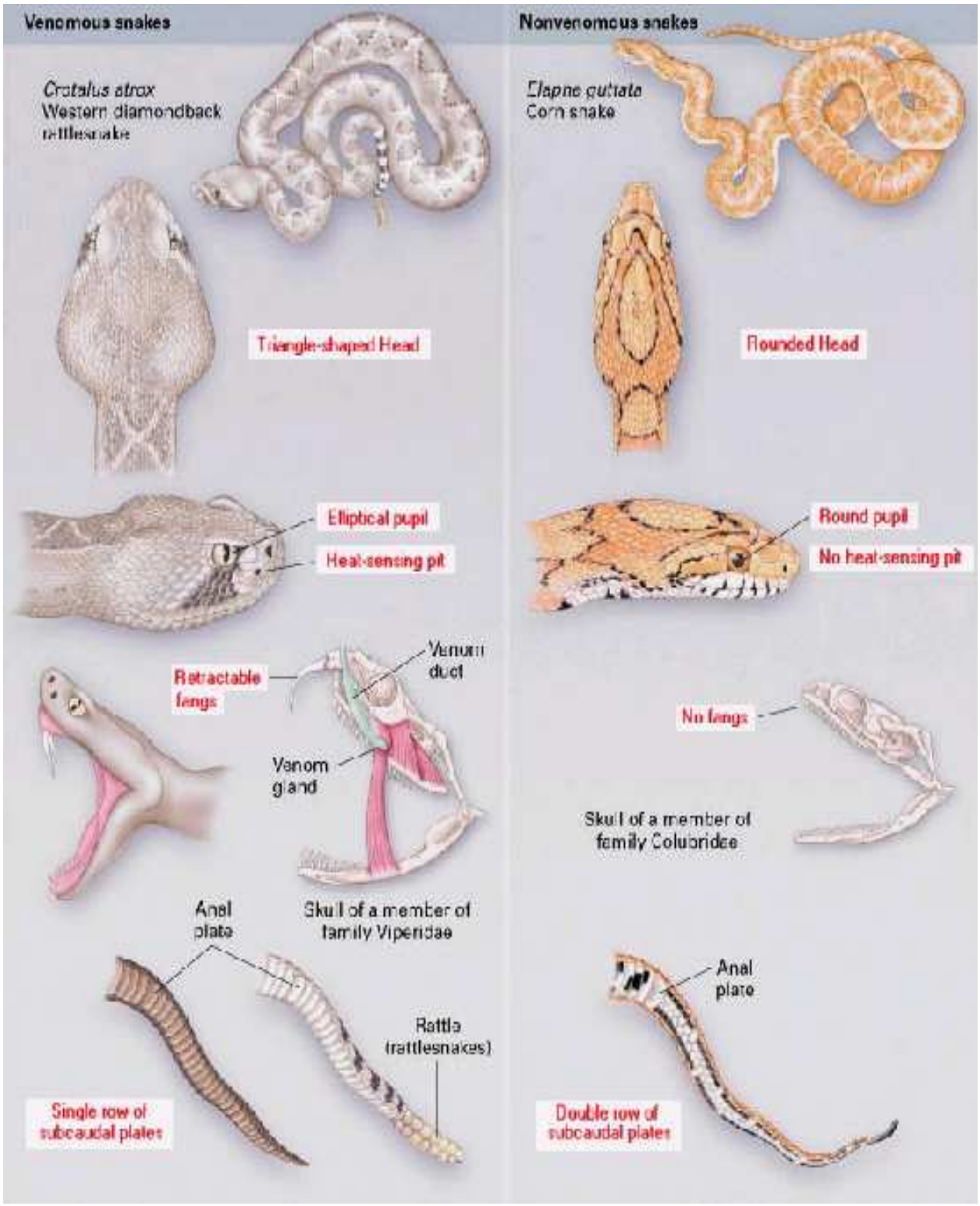
T albolabris	White-lipped green pit viper
T gramineus	Indian bamboo viper
T mucrosquamatus	Chinese habu
T purpureomaculatus	Mangrove pit viper
T stejnegeri Chinese	Bamboo viper

Saw Scaled Viper

Russell's Viper

Venomous snakes identification

1. **Pupil shape.** The pupil of harmless snakes is round. Poisonous snakes have elliptical pupils.
2. **Pit.** Poisonous snakes have a pit (hence the name “pit viper”) on each side of the head, about midway and slightly below the eye & nostril. The pit looks like a nostril & helps the snake locate warm-bodied food. Harmless snakes do not have pits.
3. **Scale arrangement.** The underside scales of a venomous snake’s tail go all the way across in a single row from the anal plate. The very tip of the tail may have two scale rows. Nonpoisonous snakes have two rows of scales from the vent to the end of the tail.
4. **Head shape.** Venomous snakes have a triangular (wide at the back and attached to a narrow neck) or “spade-shaped” head.
5. **Distinctive sound.** Rattlesnakes will usually sound a warning rattle (a buzz or a dry, whirring sound) when approached.
6. **Tail.** Cottonmouths and copper heads can be recognized by their bright yellow or greenish yellow tail.



Differences between Venomous and Nonvenomous Snakes

Composition of venom

Snake venoms contain more than 20 different constituents, mainly proteins, including enzymes and polypeptide toxins.

1. **Procoagulant enzymes** (Viperidae) that stimulate blood clotting but result in incoagulable blood. Eventually, and sometimes within 30 minutes of the bite, the levels of clotting factors have been so depleted ("consumption coagulopathy") that the blood will not clot.
2. **Haemorrhagins** (zinc metalloproteinases) damage the endothelial lining of blood vessel walls causing spontaneous systemic hemorrhage.
3. **Cytolytic or necrotic toxins** – these proteolytic enzymes and phospholipases A increase permeability resulting in local swelling.
4. **Hemolytic and myolytic phospholipases A2 -** these enzymes damage cell membranes, endothelium, skeletal muscle, nerve and red blood cells.
5. **Pre-synaptic neurotoxins** (Elapidae and some Viperidae) - these are phospholipases A2 that damage nerve endings, initially releasing acetylcholine transmitter, then interfering with release.

6. **Post-synaptic neurotoxins** (Elapidae) - these polypeptides compete with acetylcholine for receptors in the neuromuscular junction and lead to curare-like paralysis.

Quantity of venom injected at a bite

This is very variable, depending on the species and size of the snake, the mechanical efficiency of the bite, whether one or two fangs penetrated the skin and whether there were repeated strikes.

About 50% of bites by Malayan pit vipers and Russell's vipers, 30% of bites by cobras and 5-10% of bites by saw-scaled vipers do not result in any symptoms or signs of envenomation.

Bites by small snakes should not be ignored or dismissed. They should be taken just as seriously as bites by large snakes of the same species.

Incidence of snakebites

India – More than 2,00,000 snakebite are reported annually and it is estimated that between 35000 and 50,000 people die of snakebite each year.

How do snakebites happen?

Most snakebite happen when the snake is trodden on, either in the dark or in undergrowth, by someone who is bare-footed or wearing only sandals. The snake may be picked up, unintentionally in a handful of foliage or intentionally by someone who is trying to show off. Some bites occur when the snake

(usually a krait) comes in to the home at night in search of its prey (other snakes, lizards, frogs, mice) and someone sleeping on the floor rolls over onto the snake in their sleep.

Symptoms and Signs of Snake Bite

When venom has not been injected

This results from the fear of the consequences of a real venomous bite. Anxious people may over breathe so that they develop paraesthesia, stiffness or tetany of their hands and feet, dizziness, vasovagal shock.

Local symptoms and signs in the bitten part

• Local pain

• Fang marks

• Local bleeding

• Bruising

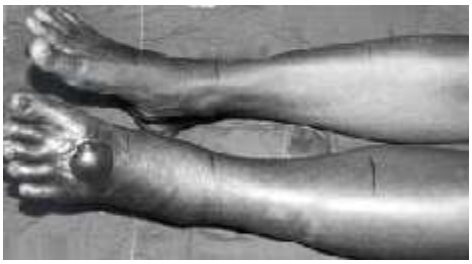
• Lymphangitis

• Lymphadenitis

• Necrosis

• Blistering, Inflammation

• Local infection, abscess formation



However, bites by kraits and sea snakes may be virtually painless and may cause negligible local swelling.

Systemic symptoms and signs

1. **General:** Nausea, vomiting, malaise, abdominal pain, weakness, drowsiness.
2. **Cardiovascular (Viperidae):** Visual disturbances, dizziness, faintness, collapse, shock, hypotension, cardiac arrhythmias, pulmonary edema, conjunctival edema.
3. **Bleeding and clotting disorders (Viperidae):**
    a. Bleeding from recent wounds (including fang marks, venepunctures etc) and from old partly-healed wounds.
    b. Spontaneous systemic bleeding – from gums, epistaxis, bleeding into the tears, haemoptysis, haematemesis, rectal bleeding or malaena, haematuria, vaginal bleeding, bleeding into the skin (petechiae, purpura, ecchymoses) and mucosae (e.g.) conjunctivae, intracranial hemorrhage.
4. **Neurological (Elapidae, Russell's viper)** Drowsiness, paraesthesiae, abnormalities of taste and smell, ptosis, external ophthalmoplegia, paralysis of facial muscles, aphonia, difficulty in swallowing secretions, respiratory and generalized flaccid paralysis.
5. **Skeletal muscle breakdown (Sea snakes, Russell's viper)** Generalized pain, stiffness and tenderness of muscles, trismus, myoglobinuria, hyperkalaemia, cardiac arrest, acute renal failure.

6. **Renal (Viperidae, Sea snakes)** Loin pain, haematuria, haemo/myoglobinuria, oliguria/anuria, uremia.
7. **Endocrine (acute pituitary/adrenal insufficiency) (Russell's viper)**

   a. Acute phase: shock, hypoglycemia

   b. Chronic phase (months to years): weakness, loss of secondary sexual hair, amenorrhoea, testicular atrophy, hypothyroidism etc

Long-term complications (sequelae) of snakebite

Chronic ulceration, infection, osteomyelitis or arthritis may persist causing severe physical disability. Malignant transformation may occur in skin ulcers after a number of years. Chronic renal failure occurs after bilateral cortical necrosis (Russell's viper bites) and chronic panhypopituitarism or diabetes insipidus after Russell's viper bites. Chronic neurological deficit is seen in the few patients who survive intracranial hemorrhages (Viperidae).

Management - First aid treatment

First aid treatment is carried out immediately or very soon after the bite, before the patient reaches a dispensary or hospital. Unfortunately, most of the traditional, popular, available and affordable first aid methods have proved to be useless or even frankly dangerous. These methods include:

a. Making local incisions at the site of the bite or in the bitten limb,

b. Attempts to suck the venom out of the wound,

c. Tying tight bands (tourniquets) around the limb,

d. Electric shock, topical application of chemicals, herbs or ice packs.

Recommended first aid methods

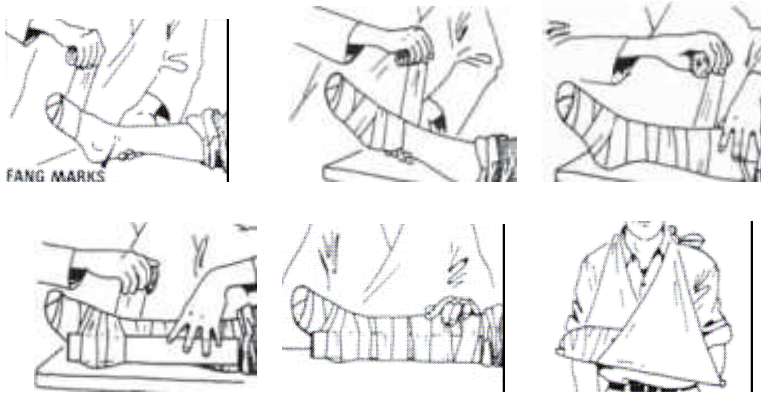
1. Reassure the victim who may be very anxious

2. Immobilise the bitten limb with a splint or sling

3. Consider pressure-immobilisation for some elapid bites

4. Avoid any interference with the bite wound as this may introduce infection, increase absorption of the venom and increase local bleeding.

Pressure immobilisation method. Ideally, an elasticated, crepe bandage, approximately 10 cm wide and at least 4.5 meters long should be used. The bandage is bound firmly around the entire bitten limb, starting distally around the fingers or toes and moving proximally, to include a rigid splint. The bandage is bound as tightly as for a sprained ankle, but not so tightly that the peripheral pulse is occluded or that a finger cannot easily be slipped between its layers.



Pressure immobilisation method

Pressure immobilisation is recommended for bites by neurotoxic elapid snakes, including sea snakes.

Early clues of envenomation

1. Snake identified is a very dangerous one
2. Rapid early extension of local swelling from the site of the bite
3. Early tender enlargement of local lymph nodes
4. Early systemic symptoms: hypotension, shock, nausea, vomiting, diarrhea, severe headache, drowsiness or early ptosis/ophthalmoplegia
5. Early spontaneous systemic bleeding
6. Passage of dark brown urine
7. Generalised pain, tenderness and stiffness of muscles and trismus

Physical examination

Examination of the bitten part

The extent of swelling, lymph nodes and overlying ecchymoses and lymphangitic lines noted. Early signs of necrosis may include blistering, demarcated darkening or paleness of the skin, loss of sensation and a smell of putrefaction (rotting flesh).

General examination

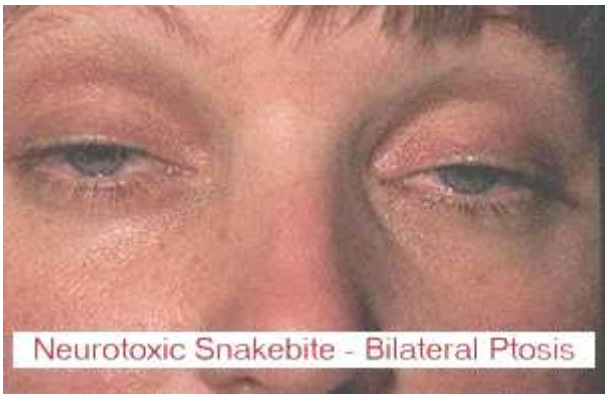
Measure the blood pressure and heart rate. Thoroughly examine the gingival sulci, using a torch and tongue depressor, as these may show the earliest evidence of spontaneous systemic bleeding. Examine the nose for

epistaxis. Abdominal tenderness may suggest gastrointestinal or retroperitoneal bleeding. Loin pain and tenderness suggests acute renal ischaemia (Russell's viper bites). Intracranial hemorrhage is suggested by lateralising neurological signs, asymmetrical pupils, convulsions or impaired consciousness.

Neurotoxic envenoming

Ask the patient to look up and observe whether the upper lids retract fully. Test eye movement. Check the size and reaction of the pupils.

Ask the patient to open their mouth wide and protrude their tongue; early restriction in mouth opening may indicate trismus (sea snake envenoming) or more often paralysis of pterygoid muscles.



Check other muscles innervated by the cranial nerves (facial muscles, tongue, gag reflex etc). The muscles flexing the neck may be paralysed, giving the "broken neck sign".

Bulbar and respiratory paralysis

Can the patient swallow or are secretions accumulating in the pharynx, an early sign of bulbar paralysis? Ask the patient to take deep breaths in and out. “Paradoxical respiration” indicates that the diaphragm is still contracting but that the intercostal muscles and accessory muscles of inspiration are paralysed. Use a peak flow meter, spirometer (FEV1 and FVC) or ask the patient to blow into the tube of a sphygmomanometer to record the maximum expiratory pressure (mmHg).

Generalised rhabdomyolysis

In victims of envenoming by sea snakes and Russell’s vipers, muscles, especially of the neck, trunk and proximal part of the limbs, may become tender and painful on active or passive movement and later may become paralysed. In sea snake bite, there is **pseudotrismus** that can be overcome by sustained pressure on the lower jaw. Myoglobinuria may be evident 3 hours after the bite.

Signs, symptoms	Cobra	Krait	Russell’s viper	Saw scaled viper	Other vipers
Local pain/tissue damage	Yes	No	Yes	Yes	Yes
Neurotoxicity	Yes	Yes	Yes!	No	No
Vasculotoxicity	No	No	Yes	Yes	Yes
Renal problems	No	No	Yes	No	Yes
Neostigmine & Atropine	Yes	No?	No?	No	No

Examination of pregnant women

There will be concern about fetal distress (revealed by fetal bradycardia), vaginal bleeding and threatened abortion. Monitoring of uterine contractions and fetal heart rate is useful. Lactating women who have been bitten by snakes should be encouraged to continue breast-feeding.

Investigations / laboratory tests

20 minute whole blood clotting test (20WBCT)

This is a very useful and informative bedside test that requires very little skill and only one piece of apparatus - a new, clean, dry, glass vessel (tube or bottle).

1. Place a few mls of freshly sampled venous blood in a small glass vessel
2. Leave undisturbed for 20 minutes at ambient temperature
3. Tip the vessel once
4. If the blood is still liquid (unclotted) and runs out, the patient has hypofibrinogenemia (“incoagulable blood”) as a result of venom-induced consumption coagulopathy
5. In the South East Asian region, incoagulable blood is diagnostic of a viper bite and rules out an elapid bite
6. If there is any doubt, repeat the test in duplicate, including a “control” (blood from a healthy person)

Other tests

1. **Hemoglobin concentration / haematocrit**: a transient increase indicates haemoconcentration resulting from a generalised increase in capillary permeability (e.g. in Russell's viper bite). More often, there is a decrease reflecting blood loss or intravascular haemolysis.
2. **Platelet count**: this may be decreased in viper bites.
3. **White blood cell count:** an early neutrophil leucocytosis is evidence of systemic envenoming from any species.
4. **Blood film**: fragmented red cells ("helmet cell", schistocytes) are seen when there is microangiopathic haemolysis.
5. **Plasma / serum** may be pinkish or brownish if there is gross haemoglobinaemia or myoglobinaemia.
6. **Biochemical abnormalities**: Muscle enzymes (creatine kinase, aldolase etc) will be elevated if there is generalized muscle damage. Mild hepatic dysfunction is reflected in slight increases in aminotransferases. Bilirubin is elevated following massive extravasation of blood. Creatinine, urea or blood urea nitrogen levels are raised in renal failure. Early hyperkalaemia may be seen following extensive rhabdomyolysis in sea snake bites. Bicarbonate will be low in metabolic acidosis.

7. **Arterial blood gases and pH** may show evidence of respiratory failure (neurotoxic envenoming) and acidaemia (respiratory or metabolic acidosis). Arterial puncture is contraindicated in patients with haemostatic abnormalities.
8. **Desaturation**: arterial oxygen desaturation can be assessed non-invasively in patients with respiratory failure or shock using a pulse oximeter.
9. **Urine examination**: the urine should be tested by dipsticks for blood/haemoglobin/myoglobin. Microscopy will confirm whether there are erythrocytes in the urine. Red cell casts indicate glomerular bleeding. Massive proteinuria is an early sign of the generalized increase in capillary permeability in Russell's viper envenoming.

Antivenom treatment

Antivenom is the only specific antidote to snake venom. Antivenom is immunoglobulin (usually the enzyme refined F (ab) 2 fragment of IgG) purified from the serum or plasma of a horse or sheep that has been immunised with the venoms of one or more species of snake.

Monovalent or monospecific antivenom neutralises the venom of only one species of snake. Polyvalent or polyspecific antivenom neutralises the venoms of several different species of snakes. For example, Haffkine, Kasauli,

Serum Institute of India and Bengal “polyvalent anti-snake venom serum” is raised in horses using the venoms of the four most important venomous snakes in India (Indian cobra, Naja naja; Indian krait, Bungarus caeruleus; Russell’s viper, Daboia russelii; saw-scaled viper, Echis carinatus).

Antibodies raised against the venom of one species may have cross-neutralising activity against other venoms, usually from closely related species. This is known as **Para specific activity**.

Indications for antivenom

Antivenom treatment is recommended if and when a patient with proven or suspected snake develops one or more of the following signs.

Systemic envenoming

1. **Haemostatic abnormalities:** spontaneous systemic bleeding, coagulopathy or thrombocytopenia
2. **Neurotoxic signs:** ptosis, external ophthalmoplegia, paralysis etc
3. **Cardiovascular abnormalities:** hypotension, shock, cardiac arrhythmia, abnormal ECG
4. **Acute renal failure:** oliguria/anuria, rising blood creatinine/ urea
5. **Haemoglobin-/myoglobin-uria:** dark brown urine, urine dipsticks, other evidence of intravascular haemolysis or generalised rhabdomyolysis (muscle aches and pains, hyperkalaemia)
6. Supporting **laboratory evidence** of systemic envenoming

Local envenoming

1. Local swelling involving more than half of the bitten limb (in the absence of a tourniquet) & swelling after bites on the digits
2. Rapid extension of swelling (e.g. beyond the wrist or ankle within a few hours of bites on the hands or feet)
3. Development of an enlarged tender lymph node draining the bitten limb

Antivenom treatment should be given as soon as it is indicated. It may reverse systemic envenoming even when this has persisted for several days or, in the case of haemostatic abnormalities, for two or more weeks. However, when there are signs of local envenoming, **without** systemic envenoming, antivenom will be effective only if it can be given within the first few hours after the bite.

Administration of antivenom

1. Adrenaline should always be kept ready.
2. Antivenom should be given by the intravenous route whenever possible.

Freeze-dried antivenoms are reconstituted, usually with 10 ml of sterile water for injection per ampoule. 2 methods of administration are recommended:

(1) Intravenous "push" injection: reconstituted freeze-dried or liquid antivenom is given by slow intravenous injection (not more than 2 ml/minute).

(2) Intravenous infusion: reconstituted freeze-dried or liquid antivenom is diluted in 250-500 ml of isotonic saline or 5% dextrose and is infused in 1 hour.

Local administration of antivenom at the bite site is not recommended.

Subcutaneous injection of antivenom

This should not be done as it is extremely painful, may increase intracompartmental pressure and has not been shown to be effective.

Intramuscular injection of antivenom

Disadvantages – poor bioavailability, haematoma formation and pain.

Situations in which intramuscular administration might be considered:

1. At a peripheral first aid station, before a patient with obvious envenoming is put in an ambulance for a journey to hospital that may last several hours;
2. When intravenous access has proved impossible.

The dose of antivenom should be divided between a number of sites in the upper anterolateral region of both thighs. A maximum of 5-10 ml should be given at each site by deep IM injection followed by massage to aid absorption.

Antivenom should never be injected into the gluteal region (upper outer quadrant of the buttock) as absorption is exceptionally slow and unreliable and there is always the danger of sciatic nerve damage.

Dose of antivenom

Snakes inject the same dose of venom into children and adults. Children must therefore be given exactly the same dose of antivenom as adults. For Mild

envenomation 5 vials, for Moderate envenomation - 10 vials and for Severe envenomation15-20 vials.

Antivenom reactions

A proportion of patients, usually more than 20%, develop a reaction either early (within a few hours) or late (5 days or more) after being given antivenom.

1. **Early anaphylactic reactions:** usually within 10-180 minutes of starting antivenom, the patient begins to itch (often over the scalp) and develops urticaria, dry cough, fever, nausea, vomiting, abdominal colic, diarrhea, tachycardia, hypotension, bronchospasm and angio-oedema.
2. **Pyrogenic (endotoxin) reactions** usually develop 1-2 hours after treatment. Symptoms include shaking chills (rigors), fever, vasodilatation and a fall in blood pressure.
3. **Late (serum sickness type) reactions** develop 1-12 (mean 7) days after treatment. Clinical features include fever, nausea, vomiting, diarrhea, itching, recurrent urticaria, arthralgia, myalgia, lymphadenopathy, periarticular swellings, mononeuritis multiplex, proteinuria with immune complex nephritis and rarely encephalopathy.

Treatment of early anaphylactic and pyrogenic antivenom reactions

1. Antivenom administration must be temporarily suspended
2. Adrenaline (0.1% solution, 1 in 1,000, 1 mg/ml)

After adrenaline, an antihistamine such as chlorpheniramine maleate, cimetidine or ranitidine should be given followed by intravenous hydrocortisone (adults 100 mg, children 2 mg/kg body weight). In pyrogenic reactions the patient must also be cooled physically and with antipyretics.

Treatment of late (serum sickness) reactions

A 5-day course of prednisolone should be given if patients fail to respond in 24-48 hours to a 5-day course of oral antihistamine.

Prediction of antivenom reactions

Skin “hypersensitivity” tests may reveal IgE mediated Type I hypersensitivity to horse or sheep proteins but do not predict the large majority of early (anaphylactic) or late (serum sickness type) antivenom reactions.

Contraindications to antivenom

There is no absolute contraindication to antivenom treatment.

Prophylaxis in high risk patients for antivenom reactions

High-risk patients may be pre-treated **empirically** with subcutaneous adrenaline, intravenous antihistamines (both anti-H1 and anti- H2) and corticosteroid. In asthmatic patients, prophylactic use of an inhaled adrenergic beta 2 agonist such as salbutamol may prevent bronchospasm.

Observation of the response to antivenom

If an adequate dose of appropriate antivenom has been administered, the following responses may be seen.

1. General: the patient feels better. Nausea, headache and generalised aches and pains may disappear very quickly.
2. Spontaneous systemic bleeding usually stops within 15- 30 minutes.
3. Blood coagulability (20WBCT) is usually restored in 3-9 hours.
4. In shocked patients, blood pressure may increase within the first 30-60 minutes and arrhythmias such as sinus bradycardia may resolve.
5. Neurotoxic envenoming of the post-synaptic type (cobra bites) may begin to improve as early as 30 minutes after antivenom, but usually take several hours. Envenoming with presynaptic toxins (kraits and sea snakes) is unlikely to respond in this way.
6. Active haemolysis and rhabdomyolysis may cease within a few hours and the urine returns to its normal colour.

Recurrence of systemic envenoming

In patients envenomed by vipers, signs of systemic envenoming may recur within 24-48 hours. This is attributable to:

1. Continuing absorption of venom from the “depot” at the site of the bite, perhaps assisted by improved blood supply following correction of shock, hypovolaemia etc, after elimination of antivenom (range of elimination halflives: IgG 45 hrs; F (ab) 2 80-100 hrs; Fab 12-18 hrs);
2. Redistribution of venom from the tissues into the vascular space, as the result of antivenom treatment.

Recurrent neurotoxic envenoming after treatment of cobra bite has also been described.

Criteria for giving more antivenom

1. Persistence or recurrence of blood incoagulability after 6 hr of bleeding
2. Deteriorating neurotoxic or cardiovascular signs after 1-2 hr

If the blood remains incoagulable (as measured by 20WBCT) **six hours after the initial dose of antivenom, the same dose should be repeated.** This is based on the observation that, if a large dose of antivenom (more than enough to neutralise the venom procoagulant enzymes) is given initially, the time taken for the liver to restore coagulable levels of fibrinogen and other clotting factors is 3-9 hours.

In patients who continue to bleed briskly, the dose of antivenom should be repeated within 1-2 hours.

In case of deteriorating neurotoxicity or cardiovascular signs, the initial dose of antivenom should be repeated after 1-2 hours, and full supportive treatment must be considered.

Complications

1. **Neurotoxic envenoming with respiratory paralysis**:

Assisted ventilation. This has proved effective, and has been followed by complete recovery, even after being maintained for periods of more than one month. Anticholinesterases should always be tried.

Anticholinesterase (e.g. “Tensilon”/edrophonium) test

Anticholinesterase drugs have a variable, but potentially very useful effect in patients with neurotoxic envenoming, especially those bitten by cobras. A trial of anticholinesterase (e.g. “Tensilon test”) should be performed in every patient with neurotoxic envenoming, as it would be in any patient with suspected myasthenia gravis.

• Baseline observations

• Give atropine intravenously

• Give anticholinesterase drug

• Observe effect

• If positive, institute regular atropine and (long acting) anticholinesterase

Atropine sulphate (adults 0.6 mg, children 50 μg/kg body weight) is given by intravenous injection (to prevent the undesirable muscarinic effects of acetylcholine such as increased secretions, sweating, bradycardia and colic) followed immediately by edrophonium chloride (adults 10 mg, children 0.25 mg/kg body weight) given intravenously over 3 or 4 minutes. The patient is observed over the next 10-20 minutes for signs of improved neuromuscular transmission. Ptosis may disappear and ventilatory capacity (peak flow, FEV1 or maximum expiratory pressure) may improve.

If edrophonium chloride is not available, any other anticholinesterases

(neostigmine, distigmine, pyridostigmine, ambenomium) can be used for this assessment but a longer period of observation will be needed (up to 1 hour). Patients who respond convincingly can be maintained on a longer-acting anticholinesterase such as neostigmine methylsulphate combined with atropine.

2. Hypotension and shock

Causes of hypotension and shock

Anaphylaxis	Antivenom reaction
Vasodilatation	Respiratory failure
Cardiotoxicity	Acute pituitary / adrenal insufficiency
Hypovolaemia	Septicaemia

Ideally, treatment with plasma expanders (colloids or crystalloid) should be controlled by observation of the central venous pressure. In patients with evidence of a generalised increase in capillary permeability, dopamine may be given by intravenous infusion (starting dose 2.5-5 μg/kg/minute). In victims of Russell's viper bites, acute pituitary / adrenal insufficiency resulting from haemorrhagic infarction of the anterior pituitary may contribute to shock. Hydrocortisone is effective in these cases.

3. Oliguria and renal failure

Most, but not all, patients with acute renal failure are oliguric, defined as a urine output of less than 400 ml/day or less than 20 ml/hour. If the patient is hypovolaemic, indicated by supine or postural hypotension, empty neck veins,

sunken eyeballs, loss of skin turgor and dryness of mucosae, proceed as follows:

(1) Establish intravenous access

(2) Insert a urethral catheter

(3) Determine the central venous pressure

(4) **Fluid challenge:** an adult patient can be given two liters of isotonic saline over one hour or, until the jugular venous pressure/central venous pressure has risen to 8-10 cm above the sternal angle. The fluid challenge must be stopped immediately if pulmonary oedema develops. If the urine output does not improve, try furosemide challenge.

(5) **Furosemide (frusemide) challenge:** 100 mg of furosemide is injected slowly (4-5 mg/minute). If this does not induce a urine output of 40 ml/hour, give a second dose of furosemide, 200 mg. If urine output does not improve, try mannitol challenge.

(6) **Mannitol challenge:** 200 ml of 20% mannitol may be infused intravenously over 20 minutes. An improvement in urine output to more than 40 ml/hr or more than 1 liter/day is considered satisfactory.

(7) **Conservative management:** If the urine output does not improve, despite these challenges, no further diuretics should be given and fluid intake should be restricted to a total of the previous day's output plus "insensible losses" (500-1000 ml/day). If possible, the patient should be referred to a renal unit.

(8) **Biochemical monitoring:** Serum potassium, urea, creatinine and, if possible, pH, bicarbonate, calcium and phosphate should be monitored.

Emergency treatment of hyperkalaemia

a. Give 10 ml of 10% calcium gluconate intravenously over 2 minutes (with ECG monitoring if possible), repeated up to three times
b. Give 50 ml of 50% dextrose with 10 units of soluble insulin intravenously
c. Sodium bicarbonate (40 ml of 8.4%) by slow intravenous infusion and a beta 2 agonist aerosol by inhaler (e.g. salbutamol 5-10 mg) may also be used. These emergency treatments will control hyperkalaemia for 3-6 hours only. If the patient is hypotensive and profoundly acidotic (deep sighing “Kussmaul” respirations, very low plasma bicarbonate concentration or very low pH - <7.10), 40 ml of 8.4% sodium bicarbonate (1 mmol/ml) may be infused intravenously over 30 minutes. If this leads to circulatory improvement, the dose can be repeated.

(9) Dialysis

Prevention of renal damage in patients with myoglobinuria or haemoglobinuria:

• correct hypovolaemia and maintain saline diuresis (if possible)

• correct severe acidosis with bicarbonate

• give a single infusion of mannitol (200 ml of 20% solution over 20 minutes)

Persisting renal dysfunction

Patients with patchy cortical necrosis show delayed and partial recovery of renal function but those with diffuse cortical necrosis require regular maintenance dialysis and eventual renal transplantation.

4. **Haemostatic disturbances**

In exceptional circumstances, such as severe bleeding or imminent urgent surgery, once specific antivenom has been given to neutralise venom procoagulants and other antihaemostatic toxins, restoration of coagulability and platelet function can be accelerated by giving fresh frozen plasma, cryoprecipitate (fibrinogen, factor VIII), fresh whole blood or platelet concentrates.

Heparin is ineffective against venom-induced thrombin and may cause bleeding on its own account. It should never be used in cases of snake bite.

Antifibrinolytic agents are not effective and should not be used.

5. **Bacterial infections**

Infection at the time of the bite with organisms from the snake’s venom and buccal cavity is a problem. Interference with the wound (incisions made with an unsterilised razor blade/knife etc) creates a risk of secondary bacterial

infection and justifies the use of broad-spectrum antibiotics (e.g. amoxycillin or a cephalosporin plus a single dose of gentamicin plus metronidazole) together with a booster dose of tetanus toxoid.

The bitten limb, which may be painful and swollen, should be nursed in the most comfortable position, preferably slightly elevated, to encourage reabsorption of edema fluid. Bullae may be large and tense but they should be aspirated only if they seem likely to rupture.

6. **Compartmental syndrome - features**

- Disproportionately severe pain
- Weakness of intracompartmental muscles
- Pain on passive stretching of intracompartmental muscles
- Hypoaesthesia
- Obvious tenseness of the compartment on palpation

The most reliable test is to measure intracompartmental pressure directly through a cannula introduced into the compartment and connected to a pressure transducer or manometer. Intracompartmental pressures exceeding 40 mmHg may carry a risk of ischaemic necrosis (e.g. Volkmann’s ischaemia or anterior tibial compartment syndrome). However, fasciotomy should not be contemplated until haemostatic abnormalities have been corrected.

AIMS AND OBJECTIVES

1. To assess the severity of snakebite envenomation.
2. To assess the dose of anti-snake venom to treat snake bites cases effectively according to severity.
3. To calculate the total requirement of ASV.

MATERIALS AND METHODS

Setting : All patients of snakebite including suspected cases of snakebite who were admitted in IV Medical unit, Department of Medicine, GRH, Madurai.

Collaborating Departments **:** Department of Pathology
Madurai Medical College
Madurai.
Department of Biochemistry
Madurai Medical College
Madurai

Design of the study **:** Descriptive study

Period of study **:** 01.01.2005 – 31.12.2005

Sample size **:** 120

Ethical committee approval **:** Obtained

Consent **:** Informed consent was obtained

Financial support **:** Nil

Conflict of interest **:** Nil

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DEFINITION

Symptoms and signs of envenomation

The symptoms and signs of snakebite envenomation were based on

1. Local findings
2. Systemic findings
3. Laboratory abnormalities

Local findings

The local findings due to snakebite envenomation are the following:

1. Puncture wounds or fang marks
2. Pain
3. Bleeding
4. Soft tissue swelling confined to the bite site or extending beyond the bite site
5. Regional lymphadenitis

Systemic findings

The systemic findings due to snakebite envenomation are the following:

1. Nausea, vomiting
2. Blurring of vision, ptosis, paraesthesia, fasciculations
3. Evidence of bleeding
4. Hypotension or shock
5. Respiratory distress – single breath count < 20

Laboratory abnormalities

The laboratory findings due to snakebite envenomation are the following

1. Prolongation of clotting time
2. Prolongation of prothrombin time
3. Decreased platelet count
4. Decreased fibrinogen
5. Increased fibrin degradation products

Severity of envenomation

The severity of snake bite envenomation were based on the local findings, systemic findings and laboratory abnormalities and the were classified into 3 types namely

1. Mild
2. Moderate
3. Severe

Mild envenomation

The features of mild envenomation include (any one)

1. Local findings – punture wounds, pain, soft tissue swelling confined to the bite site
2. Systemic findings – None
3. Laboratory abnormalities – clotting time 11 to 15 minutes

Moderate envenomation

The features of moderate envenomation include (any one)

1. Local findings – soft tissue swelling extending beyond the bite site, regional lymphadenitis
2. Systemic findings – nausea, vomiting, blurring of vision, ptosis, paraesthesia, fasciculations
3. Laboratory abnormalities – clotting time 16 to 20 minutes

Severe envenomation

The features of severe envenomation include (any one)

1. Local findings – soft tissue swelling extending beyond the bite site, regional lymphadenitis
2. Systemic findings – Evidence of bleeding, hypotension, shock, respiratory distress (single breath count < 20)
3. Laboratory abnormalities – clotting time > 20 minutes

Dose of anti-snake venom – Initial Dose

1. Mild envenomation : **5 vials**
2. Moderate envenomation : **10 vials**
3. Severe envenomation : **15 vials**

If repeat dosing is needed, the same dose in each category should be repeated depending upon the severity of envenomation.

Selection and Details of Study subjects

120 patients of snake bite with or without evidence of envenomation including suspected cases who were admitted in IV Medical unit, Department of Medicine, Govt Rajaji Hospital, during the period from 01.01.2005 – 31.12.2005 were included in the study.

Inclusion criteria

All patients admitted as a case of snakebite in IV Medical unit were taken.

Exclusion criteria

1. Patients who were treated with anti-snake venom elsewhere
2. Bleeding diathesis of any cause before snake bite

The total number of cases with Snake bite screened were 158 Of which 36 cases who had received Anti Snake Venom elsewhere and 2 patients with known history of Bleeding diathesis were excluded from the study. After exclusion of these patients, the total number of patients who were taken into account for our study were 120.

120 patients who were included in the study were divided into 4 groups each containing 30 patients.

1. Patients with No envenomation were included in **Group 1**,
2. Patients with Mild envenomation were included in **Group 2**,
3. Patients with Moderate envenomation were included in **Group 3**
4. Patients with Severe envenomation were included in **Group 4**

based on Local features, Systemic features and Lab abnormality– Clotting time as mentioned earlier. Whole blood clotting time was done to assess the severity of snakebite envenomation.

In Group I, 20 patients were males and 10 patients were females. In Group II, 16 patients were males and 14 patients were females. In Group III, 20 patients were males and 10 patients were females. In Group IV , 19 persons were males and 11 persons were females. A total number of 75 males and 45 females were selected for the study.

Polyvalent ASV was used in the study. The patients were given ASV after a sensitivity test, diluted with 500ml of dextrose or saline given over 4 hours. All patients were given IM tetanus toxoid.

The end point of the study was normalisation of haematological or neurological parameters or death.

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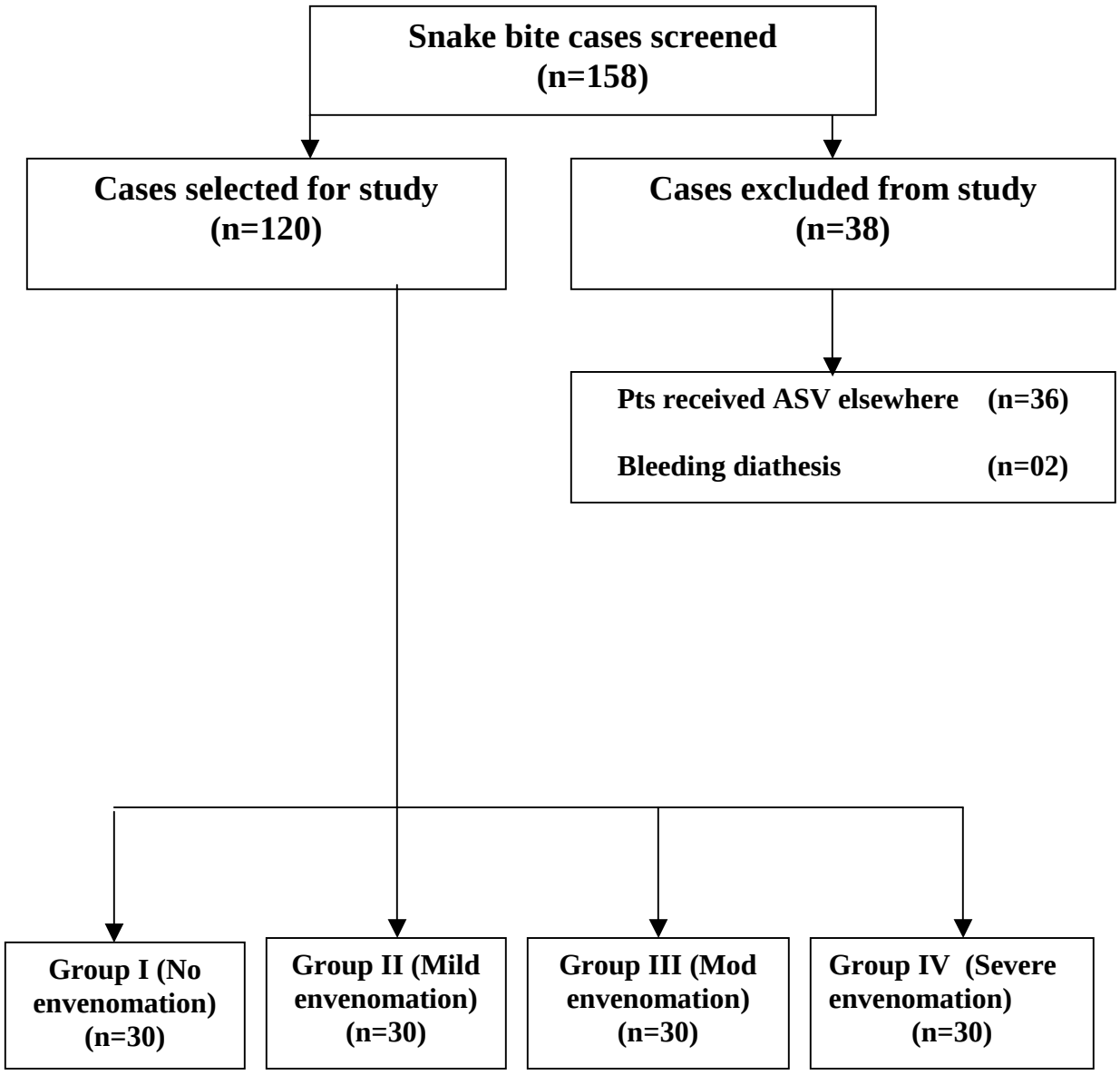

Screening of Cases – Flow chart

RESULTS

The collected data was analysed using Epidemiological information package 2002 developed by Centre for Disease Control (CDC) Atlanta in Collaboration with WHO. CHI square test was used for test of significance. These data was compared with published literature.

In our study, 120 Snakebite patients were studied.

STATISTICS

A. Study Parameters

Table 1 Total cases

Group 1	Group 2	Group 3	Group 4	Total
30	30	30	30	120

120 patients were included in the study and they were divided into 4 groups each containing 30 patients. Patients with No envenomation were included in Group 1, Patients with Mild envenomation were included in Group 2, Patients with Moderate envenomation were included in Group 3 and Patients with Severe envenomation were included in Group 4 based on Local features, Systemic features and Lab abnormalities.

Table 2 Age

Age Group	Group 1		Group 2		Group 3		Group 4	
	No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
< 21	4	13.4	7	23.3	2	6.7	3	10.0
21-30	6	20.0	8	26.7	16	53.3	10	33.3
31-40	9	30.0	9	30.0	11	36.7	9	30.0
41-50	10	33.3	6	20.0	1	3.3	7	23.4
>50	1	3.3	-	-	-	-	1	3.3
Total	30	100	30	100	30	100	30	100

'p' value > 0.05 (Not significant)

33.3% of Group 1 patients belong to 41-50 years of age, 30.0% of Group 2 patients belong to 31-40 years of age, 53.3% of Group 3 patients belong to 21-30 years of age and 33.3% of Group 4 patients belong to 21-30 years of age. 3.3% of patients in Group1 and 4 were more than 50 years of age. In Group 2 and 3, all the patients were below 50 years of age.

Table 3 Sex

Sex	Group 1		Group 2		Group 3		Group 4		Total	
	No.	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**	**No.**	**%**
Males	20	66.7	16	53.3	20	66.7	19	63.3	75	62.5
Females	10	33.3	14	46.7	10	33.3	11	36.7	45	37.5

'p' value > 0.05 (Not significant)

In Group 1, 66.7% were males and 33.3% were females. In Group 2, 53.3% were males and 46.7% were females. In Group 3, 66.7% were males and 33.3% were females. In Group 4, 63.3% were males and 36.7% were females. Overall, 62.5% of the patients included in the study were males and 37.5% were females.

Table 4 Co morbid illness

	Group 1	Group 2	Group 3	Group 4
DM	1	1	1	0
HT	1	1	1	0
IHD	1	1	1	1
COPD	1	1	1	0

Among the 120 study patients, 3 patients had Diabetes one each in Group 1, Group 2 and Group 3, 3 patients had Hypertension one each in Group 1, Group 2 and Group 3, 3 patients had Chronic Obstructive Pulmonary Disease one each in Group 1, Group 2 and Group 3 and 4 patients had Ischemic Heart Disease one each in each Group.

Table 5 Site of bite

Site of bite	Group 1		Group 2		Group 3		Group 4		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%
Upper limb	9	30.0	10	33.3	13	43.3	9	30.0	41	34.2
Lower limb	21	70.0	20	66.7	17	56.7	21	70.0	79	65.8

'p' value > 0.05 (Not significant)

In Group 1 and 4, 30% of the patients had bite in the upper limb and 70% of the patients had bite in the lower limb. In Group 2, 33.3% of the patients had bite in the upper limb and 66.7% of the patients had bite in the lower limb. In Group3, 43.3% of the patients had bite in the upper limb and 56.7% of the patients had bite in the lower limb. Among the 120 study patients, 34.2% of the patients had bite in the upper limb and 65.8% of the patients had bite in the lower limb.

Table 6 Time delay

Time Delay	< 6 hours		> 6 hours	
	No.	**%**	**No.**	**%**
Group 1	30	100.0	0	0
Group 2	27	90.0	3	10.0
Group 3	22	73.3	8	26.7
Group 4	20	66.7	10	33.3
Total	99	82.5	21	17.5

All the patients in Group 1 came to the hospital within 6 hours of snakebite for treatment even though they had no signs of envenomation. 90%, 73.3% and 66.7% of the patients in Group 1,2 and 3 respectively came to the hospital within 6 hours after snakebite. 10% of the patients in Group 2, 26.7% of the patients in Group 3 and 33.3% of the patients in Group 4 came to the hospital after 6 hours of snakebite. Overall, 82.5% of the patients came to the hospital within 6 hours of snakebite.

Table 7 Local features

Local Features	Absent		Not extending One joint		Extending beyond One joint	
	No.	**%**	**No.**	**%**	**No.**	**%**
Group 1	30	100	0	0	0	0
Group 2	0	0	30	100	0	0
Group 3	0	0	0	0	30	100
Group 4	5	16.7	0	0	25	83.3

All the patients in Group 1 had no local features of envenomation. All the patients in Group 2 had local features in the bitten area with or without lymphadenitis but not extending beyond one joint. Similarly all the patients in Group3 had local features in the bitten area but with extension of cellulitis beyond one joint. 16.7% of the Group 4 patients had no local features. 83.3% of the Group 4 patients had local features in the bitten area but with extension of cellulitis beyond one joint.

Table 8 Systemic features

Systemic Features	Absent		Mild		Severe	
	No.	**%**	**No.**	**%**	**No.**	**%**
Group 1	30	100	0	0	0	0
Group 2	30	0	0	0	0	0
Group 3	28	93.3	2	6.7	0	0
Group 4	20	66.7	4	13.3	6	20.0

All the patients in Group1 and 2 had no systemic features. 93.3% of the Group3 and 66.7% of the Group 4 patients had no systemic features. 6.7% of Group3 and 13.3% of the Group 4 patients had mild systemic features. And 20% of the Group 4 patients had severe systemic features.

Table 9 Clotting time

Clotting time	<10 min	11 – 15 min	16 – 20 min	>20 min	S.D.
Group 1	30	0	0	0	1.20
Group 2	0	30	0	0	0.63
Group 3	0	0	30	0	0.94
Group 4	5	0	0	25	-
%	29.2	25.0	25.0	20.8	-

All the patients in Group 1 and 5 patients in Group 4 had normal clotting time. All the patients in Group 2 had clotting time between 11 and 15 minutes. All the patients in Group 3 had clotting time between 16 and 20 minutes. And 25 patients in Group 4 had clotting time more than 20 minutes.

Among the 120 study patients, 29.2% had normal clotting time. 25% had clotting time between 11 and 15 minutes and another 25% had clotting time between 16 and 20 minutes. And the remaining 20.8% had clotting time more than 20 minutes.

Table 10 Toxicity

Toxicity	Absent	Hemotoxicity	Neurotoxicity
Group 1	30	0	0
Group 2	0	30	0
Group 3	0	30	0
Group 4	0	25	5
Total No	30	85	5
Total %	25.0	70.8	4.2

No symptoms and signs of envenomation were noted in Group 1 patients. All the patients in Group 2 and Group 3 had signs and symptoms of Haemotoxicity. In Group 4, Haemotoxicity was noted in 25 patients and Neurotoxicity was noted in 5 patients. Among the 120 study patients, 25% of the patients had No symptoms and signs of envenomation, 70.8% of the patients had signs and symptoms of Haemotoxicity and 4.2% had signs and symptoms of Neurotoxicity.

Table 11 ASV dose - Average

ASV dose	Nil	5 vials	10 vials	15 vials	20 vials	30 vials	Average in Vials	Average in ml	S.D
Group 1	30	0	0	0	0	0	0	0	-
Group 2	0	30	0	0	0	0	5	50	-
Group 3	0	0	28	0	2	0	10.67	106.7	1.31
Group 4	0	0	0	25	0	5	17.50	175.0	1.72

'p' value > 0.05 (Not significant)

ASV was not given for patients in Group 1 since they had no symptoms and signs of envenomation. All the patients in Group 2 were treated each with 5 vials of ASV. 28 patients in Group 3 were treated each with 10 vials of ASV and 2 patients were treated each with 20 vials of ASV. 25 patients in Group 4 were treated each with 15 vials of ASV and 5 patients were treated each with 30 vials of ASV. Average dose of ASV required were 5 vials (50ml) in Group 2, 10.67 vials (106.7ml) in Group 3 and 17.5 vials (175ml) in Group 4.

Table 12 a ASV dose – Average & Maximum

ASV dose	Average ASV given in ml	Maximum ASV given in ml
Group 1	-	-
Group 2	50.0	50
Group 3	106.7	200
Group 4	175.0	300

Maximum dose of ASV given in Group 2, Group3 and Group 4 were 50ml, 200ml and 300ml respectively.

Table 12 b Clotting Time normalization

Clotting time normalization	6 hours		12 hours	
	No.	**%**	**No.**	**%**
Group 1	-	-	-	-
Group 2	30	100.0	0	0
Group 3	28	93.3	2	6.7
Group 4	25	75.0	0	0

Clotting time was normalized in 6 hours in 100%, 93.3% and 75% of Group 2, 3 & 4 patients respectively. Clotting time was normalized in 12 hours in 6.7% of Group 3 and these patients required 20 additional vials of ASV.

Table 13 Adverse effects

Adverse effects	Present		Absent	
	No.	%	No.	%
Group 1	-	-	-	-
Group 2	8 (5 + 3)	26.7	22	73.3
Group 3	12 (9 + 3)	40.0	18	60.0
Group 4	18 (14 + 4)	60.0	12	40.0
Total	38 (28 + 10)	42.2	52	57.8

A proportion of patients develop **Antivenom reactions** namely **Early anaphylactic reactions** (within10-180 minutes)**, Pyrogenic reactions** (after1-2 hours) and **Late (serum sickness type) reactions** (after 1-12 days).In our study, 26.7% of Group 2, 40% of Group 3 & 60%Group 4 developed adverse effects to ASV. Among the 90 patients who were treated with ASV, 38 patients (42.2%) developed adverse effects to ASV & 52 patients (57.8%) had no adverse effects to ASV.

Among 8 patients who developed adverse effects to ASV in Group 2, 5 patients developed Pyrogenic reactions and 3 patients developed Anaphylactic reactions. Among 12 patients who developed adverse effects to ASV in Group 3,9patients developed Pyrogenic reactions and 3 patients developed Anaphylactic reactions. Among 18 patients who developed adverse effects to ASV in Group 4, 14 patients developed Pyrogenic reactions & 4 patients developed Anaphylactic reactions. Totally, among 38 patients who developed adverse effects to ASV, 28 patients developed Pyrogenic reactions and 10 patients developed Anaphylactic reactions. None of the patients developed Late reactions in our study.

Table 14 Complications

Complications	Nil	Renal failure	Compartmental syndrome	Respiratory failure
Group 1	-	-	-	-
Group 2	30	0	0	0
Group 3	28	1	1	0
Group 4	25	1	1	3
%	92.3	2.2	2.2	3.3

No complications were seen in Group 2 patients. Acute Renal failure was seen in 2 patients one each in Group 3 and Group 4. Similarly Compartmental syndrome was seen in 2 patients one each in Group 3 and Group 4. 3 patients in Group 4 developed Acute Respiratory failure.

92.3% had no complications, 2.2% developed Acute renal failure which was managed by Haemodialysis, 2.2% developed Compartmental syndrome which was managed with fasciotomy and 3.3% developed Acute Respiratory failure which was managed with Mechanical ventilation.

Table 15 Outcome

Outcome	Recovery	Death
Group 1	-	-
Group 2	30	0
Group 3	30	0
Group 4	30	0

All the patients in our study recovered and no death occurred.

DISCUSSION & COMPARATIVE ANALYSIS

All the patients admitted as a case of Snakebite in IV Medical unit were considered for the study and 120 patients were selected and divided into 4 Groups based on the severity of envenomation. Severity was based on symptoms and signs in the form of Local features, Systemic features and Lab abnormalities.

Patients who were treated with anti-snake venom elsewhere and patients who had Bleeding diathesis of any cause before snakebite were excluded from the study.

Careful history and physical examination was done for all patients. By history, clinical examination and Biochemical investigations, patients included in the study were grouped. 120 patients were included in the study and they were divided into 4 groups each containing 30 patients. Patients with No envenomation were included in Group 1, Patients with Mild envenomation were included in Group 2, Patients with Moderate envenomation were included in Group 3 and Patients with Severe envenomation were included in Group 4 based on Local features, Systemic features and Lab abnormalities.

Urine analysis, Random Blood sugar, Blood urea, S.creatinine, Clotting time, Prothrombin time, Complete Hemogram and ECG were done for all the patients. Clotting time was repeated every 6 hours for the patients who had

symptoms and signs of envenomation i.e. Groups 2, 3 and 4. And for patients in Group 1, Clotting time was repeated every 2 hours.

The presence and absence of Adverse effects of ASV, Complications of envenomation were noted. Normalisation of Clotting time after ASV therapy was also noted. Total dose of ASV required in each group was calculated.

COMPARATIVE ANALYSIS

120 patients were included in our study and they were divided into 4 groups each containing 30 patients. V Paul et al conducted study in 100 patients and they were divided into 2 groups each containing 50 patients. J Srimannarayana et al conducted study in 90 patients and they were divided into 3 groups each containing 30 patients.

The majority of patients in the study group were in the age group of 21-30 years. In V Paul et al study, majority of patients in the study group were in the age group of 30-50 years.

62.5% of the patients in the study group were males and 37.5% were females in our study. In V Paul et al study, 75% were males and 25% were females.

In our study, 65.8% of bites occurred in lower limbs and 34.2% occurred in upper limbs. In V Paul et al study, 80% of bites occurred in lower limbs and 20% occurred in upper limbs.

Overall, 82.5% of the patients came to the hospital within 6 hours of snakebite.

16.7% of the Group 4 patients had no local features & 83.3% had local features in the bitten area but with extension of cellulitis beyond one joint.

93.3% of the Group3 and 66.7% of the Group 4 patients had no systemic features. 6.7% of Group3 and 13.3% of the Group 4 patients had mild systemic features. And 20% of the Group 4 patients had severe systemic features.

29.2% of the study patients had clotting time <10 minutes, 25% had clotting time 11-15 minutes, 25% had clotting time 16-20 minutes and 20.8% had clotting time >20 minutes. In V Paul et al study, the average clotting time on the day of admission was 23.9 minutes in high dose group and 21.4 minutes in low dose group. J Srimannarayana et al study showed clotting time 26.2 min, 22.2 min and 25 min for Group 1, 2 and 3 respectively. The difference in clotting time may be due to the fact that 30 patients in our study had no envenomation and only Hemotoxic snakebite patients were included in J Srimannarayana et al study.

In our study, 70.8% of the patients had Haemotoxicity and 4.2% had Neurotoxicity. In V Paul et al study, 74% of the patients had Haemotoxicity, 16% had Neurotoxicity and the remaining 10% had both. Only Hemotoxic snakebite patients were included in J Srimannarayana et al study. Hemotoxicity was almost similar when compared with V Paul et al study.

Average dose of ASV required were 5 vials (50ml) in Group 2, 10.67 vials (106.7ml) in Group 3 and 17.5 vials (175ml) in Group 4.In V Paul et al study, a fixed dose of 6 vials (60ml) and 12 vials (120ml) were used for Low dose group and High dose group respectively. In J Srimannarayana et al study, 376 ml, 197.67 ml and 205.33 ml were given for Regimen I, II and III respectively. The reason for decreased quantity of ASV requirement in our study when compared with J Srimannarayana et al study is due to the fact that in our study, patients were grouped according to the severity of envenomation, which was not done in J Srimannarayana et al study.

Maximum dose of ASV given in Group 2, Group3 and Group 4 were 50ml, 200ml and 300ml respectively.

Clotting time was normalized in 6 hours in 86.7% of patients and in 12 hours in 6.7% of patients in our study. In J Srimannarayana et al study, time lapse for clotting time normalization was 20.67 hours, 16.55 hours and 13.4 hours in Regimen I, II and III respectively. The bite to needle time in J Srimannarayana et al study was 17 hours, 24.14 hours and 12 hours in Regimen I, II and III respectively and this delayed arrival to the hospital could be the reason for delay in clotting time normalization.

8 patients of Group 2, 12 patients of Group 3 and 18 patients of Group 4 developed adverse effects to ASV. Among the 90 patients who were treated

with ASV, 38 patients (42.2%) developed adverse effects to ASV and 52 patients (57.8%) had no adverse effects to ASV.

In our study, among the 90 patients who were treated with ASV, 92.3% had no complications, 2.2% developed Acute renal failure, 2.2% developed Compartmental syndrome and 3.3% developed Acute Respiratory failure. In V Paul et al study, 22% developed Acute Renal Failure and 2% developed Acute Respiratory Failure. In J Srimannarayana et al study, 52.2% developed Acute Renal Failure. Again the delayed arrival to the hospital may be the reason for increased incidence of Acute renal failure in J Srimannarayana et al study.

All the patients in our study recovered and no death occurred. In V Paul et al study, mortality rate was 12% and in J Srimannarayana et al study, mortality rate was 22.2%. Delayed arrival to the hospital, lack of categorisation based on severity of envenomation and increased incidence of complications could be the reasons for increased mortality rate in V Paul et al study and in J Srimannarayana et al study.

CONCLUSION

1. 62.5% of the patients were males and 37.5% were females.
2. 65.8% of the patients had bite in the lower limb and 34.2% had bite in the upper limb.
3. 82.5% of the patients came to the hospital within 6 hours of snakebite and 17.5% came to the hospital after 6 hours.
4. 29.2% of the patients had clotting time <10 minutes, 25% had clotting time 11-15 minutes, 25% had clotting time 16-20 minutes and 20.8% had clotting time >20 minutes.
5. 70.8% of the patients had Haemotoxicity and 4.2% had Neurotoxicity.
6. Average dose of ASV required were 5 vials (50ml) in Group 2, 10.67 vials (106.7ml) in Group 3 & 17.5 vials (175ml) in Group 4.
7. Maximum dose of ASV given in Group 2, Group 3 and Group 4 were 50ml, 200ml and 300ml respectively.
8. Clotting time was normalized in 6 hours in 86.7% of patients and in 12 hours in 6.7% of patients.
9. 38 patients (42.2%) developed adverse effects to ASV and 52 patients (57.8%) had no adverse effects to ASV.

10. 92.3% had no complications, 2.2% developed Acute Renal failure, 2.2% developed Compartmental syndrome and 3.3% developed Acute Respiratory failure.
11. All the patients in our study recovered and no death occurred.

SUMMARY

The study **"Snake Bite Envenomation and Anti Snake Venom – A Descriptive study"** was done in 120 patients of Snakebite admitted in IV Medical unit, Department of Medicine, Government Rajaji Hospital, Madurai. 120 patients were divided into 4 groups each containing 30 patients. Patients with No envenomation were included in Group 1, Patients with Mild envenomation were included in Group 2, Patients with Moderate envenomation were included in Group 3 and Patients with Severe envenomation were included in Group 4 based on Local features, Systemic features and Lab abnormalities.

The patients who satisfied the inclusion criteria underwent various investigations like Urine analysis, Random Blood sugar, Blood urea, S.creatinine, Clotting time, Prothrombin time, Complete Hemogram and ECG were done for all the patients. Clotting time was repeated every 6 hours for the patients who had symptoms and signs of envenomation i.e. Groups 2, 3 and 4. And for patients in Group 1, Clotting time was repeated every 2 hours.

The severity of snake bite envenomation, the dose of anti-snake venom to treat snakebites cases effectively according to severity and the total requirement of ASV were assessed.

Majority of patients in the study group were in the age group of 21-30 years. Most of the patients were males.

Most of the patients had snakebite in the lower limbs. Haemotoxic snakebite was more common than neurotoxic snakebite.

The average dose and the maximum dose of Anti Snake Venom increased as the severity of Snake bite envenomation increased.

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GLOSSARY

AE	- Adverse Effects
ASV	- Anti Snake Venom
COPD	- Chronic Obstructive Pulmonary Disease
CT	- Clotting Time
CTN	- Clotting Time Normalisation
DM	- Diabetes Mellitus
GRH	- Government Rajaji Hospital
HT	- Hypertension
IHD	- Ischemic Heart Disease
LA	- Lab Abnormalities
LF	- Local Features
P	- Pregnancy
SF	- Systemic Features
TD	- Time Delay

PROFORMA

1. Name 2. Age 3. Sex

4. Address

5. Time delay before hospitalization
   (a) Less than 6 hours (b) More than 6 hours

6. Pre-hospital treatment with ASV

7. Snakes brought for identification (type of snake)

8. Site of bite

9. Bite wound incised or not

10. Clinical features
    (a) Local features

    (b) Systemic features

11. Nature of Envenomation
    (a) Hemotoxic (b) Neurotoxic (c) Both

12. Vital signs
    (a) Pulse rate (b) Respiratory rate
    (c) Single breath count (d) Blood pressure

13. Co-morbid status: 14. Pregnancy

15. Cardio vascular status 16. Respiratory status

17. Neurological status 18. Renal status

19. Laboratory studies
    a. Clotting time :
       D1 D2 D3 D4 D5
    b. Urine analysis : Blood urea :

c. Serum creatinine : Blood Sugar

d. Serum Potassium ECG :

e. Prothrombin time :

f. Complete Hemogram :
Hb TC DC
ESR PCV
RBC count Platelet count
BT CT
Peripheral smear
RBC`s
WBC`s
Platelets

20. ASV dose required

21. Adverse reactions to ASV

22. Time lapse for CT normalization

23. Recurrent Coagulopathy

24. Complications
(a) ARF (b) Respiratory failure

(c) Compartment syndrome (d) DIC

(e) Others

25. Duration of stay

26. Outcome 27. Others

K. Dis.No. 27144/E4/1/2005.

Govt. Rajaji Hospital,
Madurai – 625 020. Dt. 06.04.06.

Sub: Establishment – Govt. Rajaji Hospital, Madurai – Ethical Committee Projects approved by the Committee – Intimation – Sent – Reg.

The Ethical Committee of the Govt. Rajaji Hospital, Madurai was held at 12 Noon on 01.04.2006 at the Dean's Chamber, Govt. Rajaji Hospital, Madurai, and the following Projects were approved unanimously by the Committee Members.

S.No.	Name of the Student	Name of the Project approved
01)	Dr.G.Madhusudhanan, CRRI,Govt. Rajaji Hospital.	Diabetic Foot Syndrome.
02)	Dr. G, Ramesh, PG in MD (Gen.Med.) Madurai Medical College.	Micro albumin Urea in HIV/AIDS patients.
03)	Dr. P. Thirumalaikolundu Subramanian, Professor & HOD of Medicine.	Autonomic Neuropathy among AIDS cases
04)	-do-	Lidovudine level in AIDS cases
05)	-do-	Lactic acid levels among AIDS cases
06)	-do-	Post Traumatic stress disorder among AIDS patients.
07)	-do-	Computer knowledge and lifestyle among HCWS
08)	Dr. D. Babu Vinish, PG in MD(Gen. Med.) Madurai Medical College.	Target organ damage in hypertension.
09)	Dr. K. Sidharthan, PG in MD.(Gen. Med.) Madurai Medical College.	Serum Sodium Potassium profile in hypertensives.
10)	Dr. Revathy Janakiraman, Addl.Prof.of Obst.& Gyn. Madurai Medical College.	Changing trends in Caesarean sections
11)	-do-	Awareness of contraceptives and HIV among unwed pregnant teenagers.
12)	Dr. V. Pavanasakumar, PG in MD(Gen. Medi.) Madurai Medical College.	Echocardiographic assessment of Cardiac dysfunction in patients of Chronic renal failure.
13)	Dr. M. Rajkumar, PG in MD (Gen.Med.) Madurai Medical College.	Optimal use of Anti-Snake venom in snake-bite envenomation.
14)	Dr.O.Chandran, PG in MD(Gen.Med.)	Socio demographic and Clinical aspects of acute diarrhoeal disease among adults.

S.No.	Name of the Student	Name of the Project approved
15)	Dr. P. Thirumalaikolundu Subramanian, Professor & HOD of Medicine, .	Injection practices among CRRIs.
16)	-do-	Specific learning disorders among HIV positive children.
17)	Dr. D. David Praveen Kumar, PG in MD(Gen.Med.)	Elderly Tuberculosis.
18)	Dr. Vipindas.C. PG in MD (Gen.Med.)	Music and Memory.
19)	Dr.M. Srinivasan, MBBS Student, Madurai Medical College.	Prevalance of Lipodystrophy among HIV/AIDS patients.
20)	Dr.E. Manivannan, PG in Pharmacology.	Cutaneous drug eruptions with special reference to non steroidal anti-inflammatory drugs.
21)	Dr. K. Baskaran, PG in Pharmacology.	Prescriptions and Doctors.
22)	Dr. S. Murugesan, PG in MD (Gen.Med.)	Congestive Cardiac failure.

Please note that the investigator should adhere the following:-

01) She/He should get a detailed informed consent from the patients/participants and maintain confidentially.
02) She/He should carry out the work without detrimental to regular activities as well as without extra expenditure to the Institution or Government.
03) She/He should inform the Institution Ethical Committee in case of any change of study procedure site and investigation or guide.
04) She/He should not deviate for the area of the work for which applied for Ethical clearance.
05) She/He should inform the IEC immediately, in case of any adverse events or serious adverse reactions.
06) She/He should abide to the rules and regulations of the Institution.
07) She/He should complete the work within the specific period and apply for, if any extension of time is required, She/He should apply for permission again and do the work.
08) She/He should submit the summary of the work to the Ethical Committee on completion of the work.
09) She/He should not claim any funds from the Institution while doing the work or on completion.
10) She/He should understand that the members of IEC have the right to monitor the work with prior intimation.

Dean/Chairman,
Ethical Committee, Govt. Rajaji Hospital, Madurai.

MASTER CHART

Sl.No	AGE	SEX	GROUP	DM	HT	IHD	COPD	P	SITE	TD	LF	SF	LA	CT	TOXICITY	ASV	CTN	AE	COMPL	OUTCOME
1	46	1	1	2	2	2	2		1	1	1	1	1	1	1					1
2	20	2	1	2	2	2	2	2	1	1	1	1	1	1	1					1
3	28	1	1	2	2	2	2		2	1	1	1	1	1	1					1
4	32	2	1	2	2	2	2	2	2	1	1	1	1	1	1					1
5	41	1	1	2	2	2	2		2	1	1	1	1	1	1					1
6	38	2	1	2	2	2	2	2	2	1	1	1	1	1	1					1
7	65	1	1	1	2	1	2		2	1	1	1	1	1	1					1
8	39	1	1	2	2	2	2		2	1	1	1	1	1	1					1
9	49	2	1	2	2	2	1	2	2	1	1	1	1	1	1					1
10	21	1	1	2	2	2	2		2	1	1	1	1	1	1					1
11	18	1	1	2	2	2	2		2	1	1	1	1	1	1					1
12	31	2	1	2	2	2	2	2	1	1	1	1	1	1	1					1
13	40	1	1	2	2	2	2		2	1	1	1	1	1	1					1
14	37	1	1	2	2	2	2		2	1	1	1	1	1	1					1
15	38	2	1	2	2	2	2	2	2	1	1	1	1	1	1					1
16	46	1	1	2	1	2	2		2	1	1	1	1	1	1					1
17	20	2	1	2	2	2	2	2	1	1	1	1	1	1	1					1
18	24	1	1	2	2	2	2		2	1	1	1	1	1	1					1
19	34	1	1	2	2	2	2		2	1	1	1	1	1	1					1
20	39	2	1	2	2	2	2	2	2	1	1	1	1	1	1					1
21	30	1	1	2	2	2	2		2	1	1	1	1	1	1					1
22	41	1	1	2	2	2	2		2	1	1	1	1	1	1					1
23	44	2	1	2	2	2	2	2	1	1	1	1	1	1	1					1
24	29	1	1	2	2	2	2		2	1	1	1	1	1	1					1
25	48	1	1	2	2	2	2		2	1	1	1	1	1	1					1
26	41	1	1	2	2	2	2		2	1	1	1	1	1	1					1
27	45	2	1	2	2	2	2	2	1	1	1	1	1	1	1					1
28	29	1	1	2	2	2	2		1	1	1	1	1	1	1					1
29	20	1	1	2	2	2	2		1	1	1	1	1	1	1					1
30	43	1	1	2	2	2	2		1	1	1	1	1	1	1					1

Sl.No	AGE	SEX	GROUP	DM	HT	IHD	COPD	P	SITE	TD	LF	SF	LA	CT	TOXICITY	ASV	CTN	AE	COMPL	OUTCOME
31	40	1	2	2	2	2	2		2	1	2	1	2	2	2	1	1	2	1	1
32	35	1	2	2	2	2	2		2	1	2	1	2	2	2	1	1	2	1	1
33	25	2	2	2	2	2	2	2	2	1	2	1	2	2	2	1	1	2	1	1
34	35	1	2	2	2	2	2		2	1	2	1	2	2	2	1	1	2	1	1
35	20	2	2	2	2	2	2	2	2	1	2	1	2	2	2	1	1	1	1	1
36	23	2	2	2	2	2	2	2	1	1	2	1	2	2	2	1	1	2	1	1
37	29	1	2	2	2	2	2		2	1	2	1	2	2	2	1	1	2	1	1
38	33	2	2	2	2	2	2	2	1	1	2	1	2	2	2	1	1	1	1	1
39	32	1	2	2	2	2	2		1	1	2	1	2	2	2	1	1	1	1	1
40	30	2	2	2	2	2	2	2	1	1	2	1	2	2	2	1	1	1	1	1
41	46	2	2	1	2	1	2	2	2	1	2	1	2	2	2	1	1	2	1	1
42	37	1	2	2	2	2	2	2	2	2	2	1	2	2	2	1	1	1	1	1
43	21	2	2	2	2	2	2	2	2	1	2	1	2	2	2	1	1	2	1	1
44	18	1	2	2	2	2	2		1	1	2	1	2	2	2	1	1	2	1	1
45	19	1	2	2	2	2	2		2	1	2	1	2	2	2	1	1	2	1	1
46	41	2	2	2	2	2	2	2	1	1	2	1	2	2	2	1	1	2	1	1
47	25	1	2	2	2	2	2		2	1	2	1	2	2	2	1	1	1	1	1
48	27	1	2	2	2	2	2		2	1	2	1	2	2	2	1	1	1	1	1
49	44	2	2	2	1	2	2	2	2	1	2	1	2	2	2	1	1	2	1	1
50	42	2	2	2	2	2	2	2	2	2	2	1	2	2	2	1	1	2	1	1
51	32	1	2	2	2	2	2		2	1	2	1	2	2	2	1	1	2	1	1
52	35	1	2	2	2	2	2		2	1	2	1	2	2	2	1	1	2	1	1
53	40	2	2	2	2	2	2	2	2	2	2	1	2	2	2	1	1	1	1	1
54	19	1	2	2	2	2	2		1	1	2	1	2	2	2	1	1	2	1	1
55	17	2	2	2	2	2	2	2	1	1	2	1	2	2	2	1	1	2	1	1
56	18	1	2	2	2	2	2		1	1	2	1	2	2	2	1	1	2	1	1
57	20	1	2	2	2	2	2		1	1	2	1	2	2	2	1	1	2	1	1
58	48	2	2	2	2	2	1	2	2	1	2	1	2	2	2	1	1	2	1	1
59	23	2	2	2	2	2	2	2	2	1	2	1	2	2	2	1	1	2	1	1
60	45	1	2	2	2	2	2		2	1	2	1	2	2	2	1	1	2	1	1

Sl.No	AGE	SEX	GROUP	DM	HT	IHD	COPD	P	SITE	TD	LF	SF	LA	CT	TOXICITY	ASV	CTN	AE	COMPL	OUTCOME
61	23	1	3	2	2	2	2		2	1	3	1	2	3	2	2	1	2	1	1
62	28	1	3	2	2	2	2		2	1	3	1	2	3	2	2	1	1	1	1
63	42	1	3	1	2	2	2		2	1	3	1	2	3	2	2	1	2	1	1
64	18	2	3	2	2	2	2	2	2	1	3	1	2	3	2	2	1	1	1	1
65	31	1	3	2	2	2	2		2	1	3	1	2	3	2	2	1	1	1	1
66	36	1	3	2	2	2	2		1	1	3	1	2	3	2	2	1	1	1	1
67	25	2	3	2	2	2	2	2	2	1	3	1	2	3	2	2	1	2	1	1
68	27	1	3	2	2	2	2		1	2	3	2	2	3	2	4	2	2	1	1
69	29	1	3	2	2	2	2		2	1	3	1	2	3	2	2	1	2	1	1
70	30	2	3	2	2	2	2	2	1	1	3	1	2	3	2	2	1	1	2	1
71	32	1	3	2	2	2	2		2	1	3	1	2	3	2	2	1	1	1	1
72	19	1	3	2	2	2	2		2	1	3	1	2	3	2	2	1	1	1	1
73	40	2	3	2	2	2	1	2	2	1	3	1	2	3	2	2	1	2	1	1
74	27	1	3	2	2	2	2		1	2	3	1	2	3	2	2	1	2	1	1
75	33	2	3	2	2	2	2	2	2	2	3	1	2	3	2	2	1	2	1	1
76	40	2	3	2	1	2	2	2	2	1	3	1	2	3	2	2	1	2	1	1
77	29	1	3	2	2	2	2		1	2	3	2	2	3	2	4	2	2	1	1
78	36	1	3	2	2	2	2		1	1	3	1	2	3	2	2	1	1	1	1
79	29	1	3	2	2	2	2		2	1	3	1	2	3	2	2	1	1	3	1
80	26	2	3	2	2	2	2	2	1	1	3	1	2	3	2	2	1	2	1	1
81	38	1	3	2	2	2	2		1	2	3	1	2	3	2	2	1	2	1	1
82	30	2	3	2	2	2	2	2	2	1	3	1	2	3	2	2	1	2	1	1
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86	29	2	3	2	2	2	2	2	2	2	3	1	2	3	2	2	1	1	1	1
87	31	1	3	2	2	2	2		1	2	3	1	2	3	2	2	1	2	1	1
88	28	2	3	2	2	2	2	2	2	1	3	1	2	3	2	2	1	2	1	1
89	34	2	3	2	2	2	2	2	1	1	3	1	2	3	2	2	1	2	1	1
90	29	1	3	2	2	2	2		2	1	3	1	2	3	2	2	1	2	1	1

Sl.No	AGE	SEX	GROUP	DM	HT	IHD	COPD	P	SITE	TD	LF	SF	LA	CT	TOXICITY	ASV	CTN	AE	COMPL	OUTCOME
91	23	1	4	2	2	2	2		2	1	3	1	2	4	2	3	1	2	1	1
92	26	1	4	2	2	2	2		2	1	3	2	2	4	2	3	1	1	1	1
93	39	2	4	2	2	2	2	2	2	1	3	1	2	4	2	3	1	1	1	1
94	49	1	4	2	2	2	2		2	1	3	3	2	4	2	3	1	1	1	1
95	47	2	4	2	2	2	2	2	1	2	1	3	1	1	3	5		2	4	1
96	31	2	4	2	2	2	2	2	2	1	3	2	2	4	2	3	1	1	1	1
97	42	1	4	2	2	2	2		1	1	3	1	2	4	2	3	1	2	1	1
98	29	1	4	2	2	2	2		2	1	3	1	2	4	2	3	1	1	1	1
99	20	2	4	2	2	2	2	2	2	2	3	2	2	4	2	3	1	1	1	1
100	30	1	4	2	2	2	2		2	1	3	3	2	4	2	3	1	1	1	1
101	38	1	4	2	2	2	2		1	1	3	3	2	4	2	3	1	2	1	1
102	46	1	4	2	2	2	2		2	1	3	1	2	4	2	3	1	1	1	1
103	19	1	4	2	2	2	2		1	2	1	1	1	1	3	5		2	1	1
104	51	2	4	2	2	2	2	2	2	2	3	1	2	4	2	3	1	2	1	1
105	50	1	4	2	2	1	2		1	1	3	1	2	4	2	3	1	1	1	1
106	39	2	4	2	2	2	2	2	2	1	3	1	2	4	2	3	1	2	2	1
107	27	1	4	2	2	2	2		2	2	3	1	2	4	2	3	1	1	1	1
108	35	1	4	2	2	2	2		2	1	3	2	2	4	2	3	1	1	1	1
109	40	1	4	2	2	2	2		2	1	3	1	2	4	2	3	1	1	1	1
110	25	2	4	2	2	2	2	2	2	1	3	1	2	4	2	3	1	2	3	1
111	48	1	4	2	2	2	2		1	2	1	1	1	1	3	5		2	1	1
112	30	1	4	2	2	2	2		2	1	3	1	2	4	2	3	1	1	1	1
113	38	1	4	2	2	2	2		2	1	3	1	2	4	2	3	1	2	1	1
114	17	1	4	2	2	2	2		1	1	1	3	1	1	3	5		1	4	1
115	30	1	4	2	2	2	2		2	1	3	1	2	4	2	3	1	1	1	1
116	35	2	4	2	2	2	2	2	2	2	3	1	2	4	2	3	1	1	1	1
117	50	2	4	2	2	2	2	2	1	2	1	3	1	1	3	5		1	4	1
118	26	1	4	2	2	2	2		2	2	3	1	2	4	2	3	1	2	1	1
119	30	1	4	2	2	2	2		1	1	3	1	2	4	2	3	1	2	1	1
120	38	2	4	2	2	2	2	2	2	2	3	1	2	4	2	3	1	1	1	1

Sex: 1-Male, 2-Female

DM: 1-Present, 2-Absent

IHD: 1-Present, 2-Absent

Pregnancy: 1- Non pregnant

Time delay: 1<6 hours, 2 >6 hours

Systemic features: 1-Absent,
2-Mild, 3-Severe

Clotting time: 1 < 10 min, 1-11 to 15 min,
3-16 to 20 min, 4 > 20 min

ASV: 1-5 vials, 2-10 vials, 3-15 vials,
4-20 vials, 5-30 vials

Adverse effects: 1-Present, 2-Absent

Outcome: 1-Recovery, 2-Death

Group: 1-No envenomation, 2-Mild, 3-Moderate, 4-Severe

HT: 1-Present, 2-Absent

COPD: 1-Present, 2-Absent

Site of bite: 1-Upper limb, 2-Lower limb

Local features: 1-Absent
2-Cellulitis not extending one joint,
3-Cellulitis extending beyond one joint

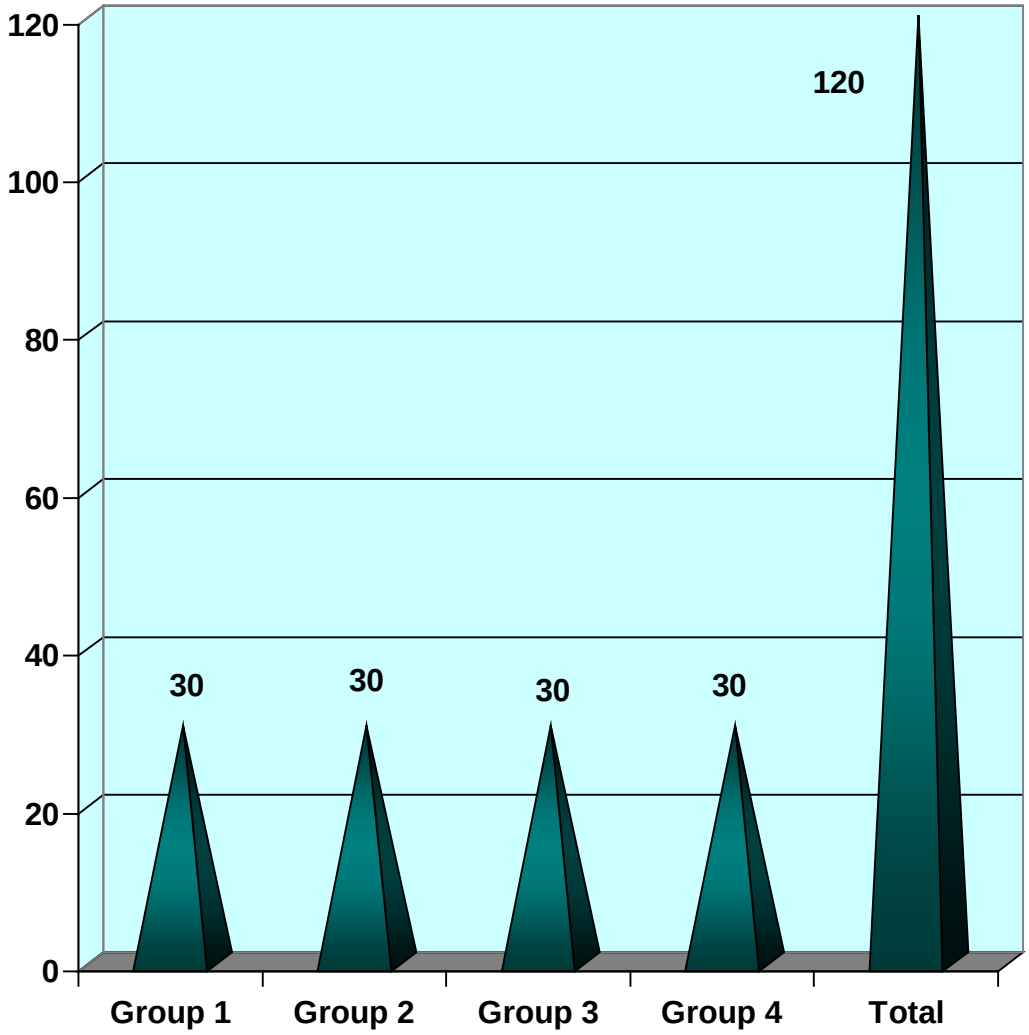
Lab abnormalities: 1-Absent, 2-Present

Toxicity: 1-Hemo, 2-Neuro

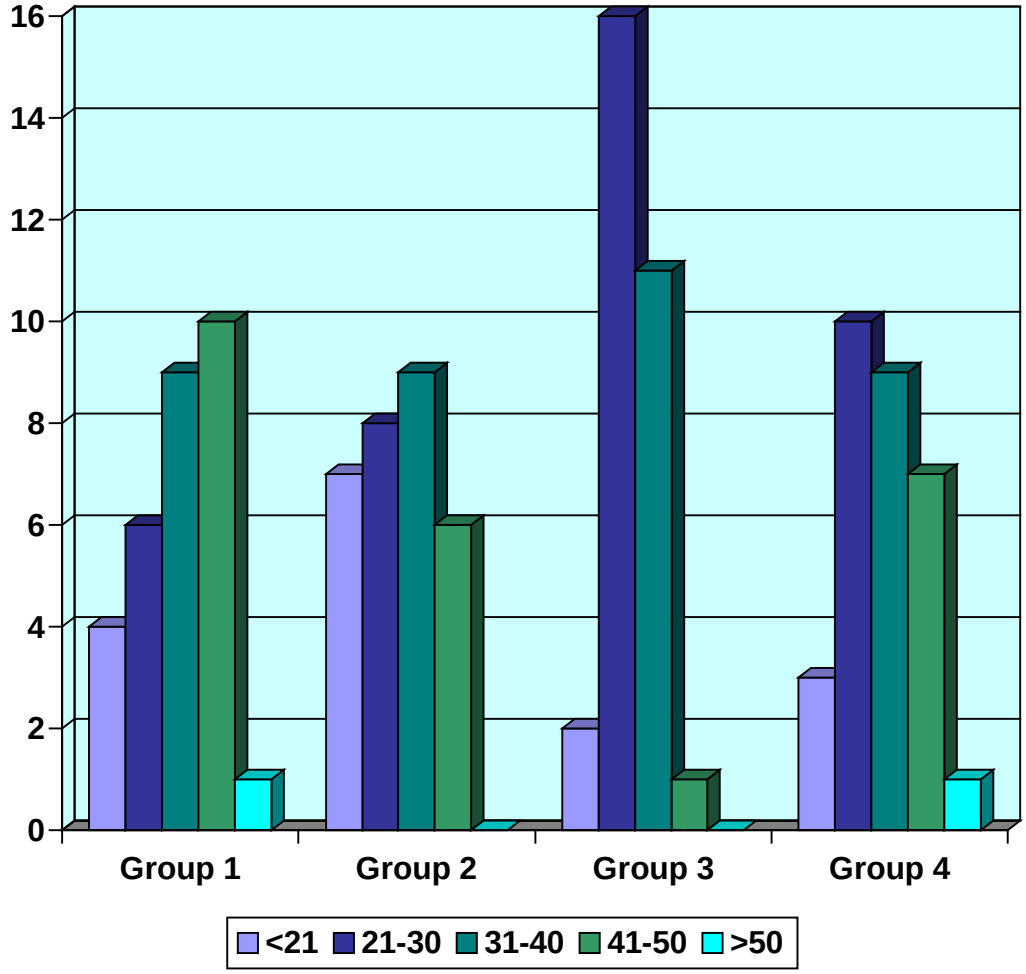
CT normalisation: 1-6 hours, 2-12 hours

Complications: 1-Nil, 2- Renal failure,
3-Compartmental syndrome,
4-Respiratory failure

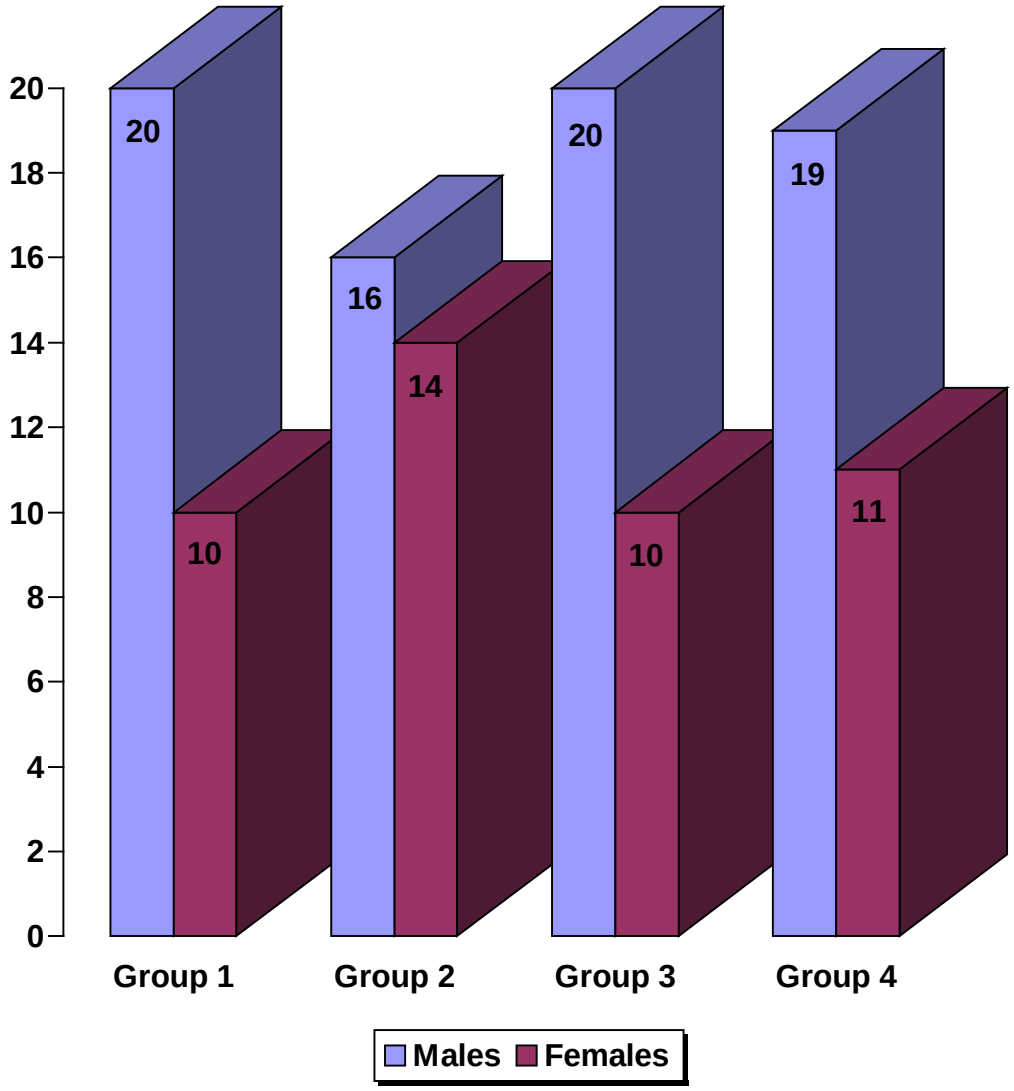
Graph 1 - Total cases



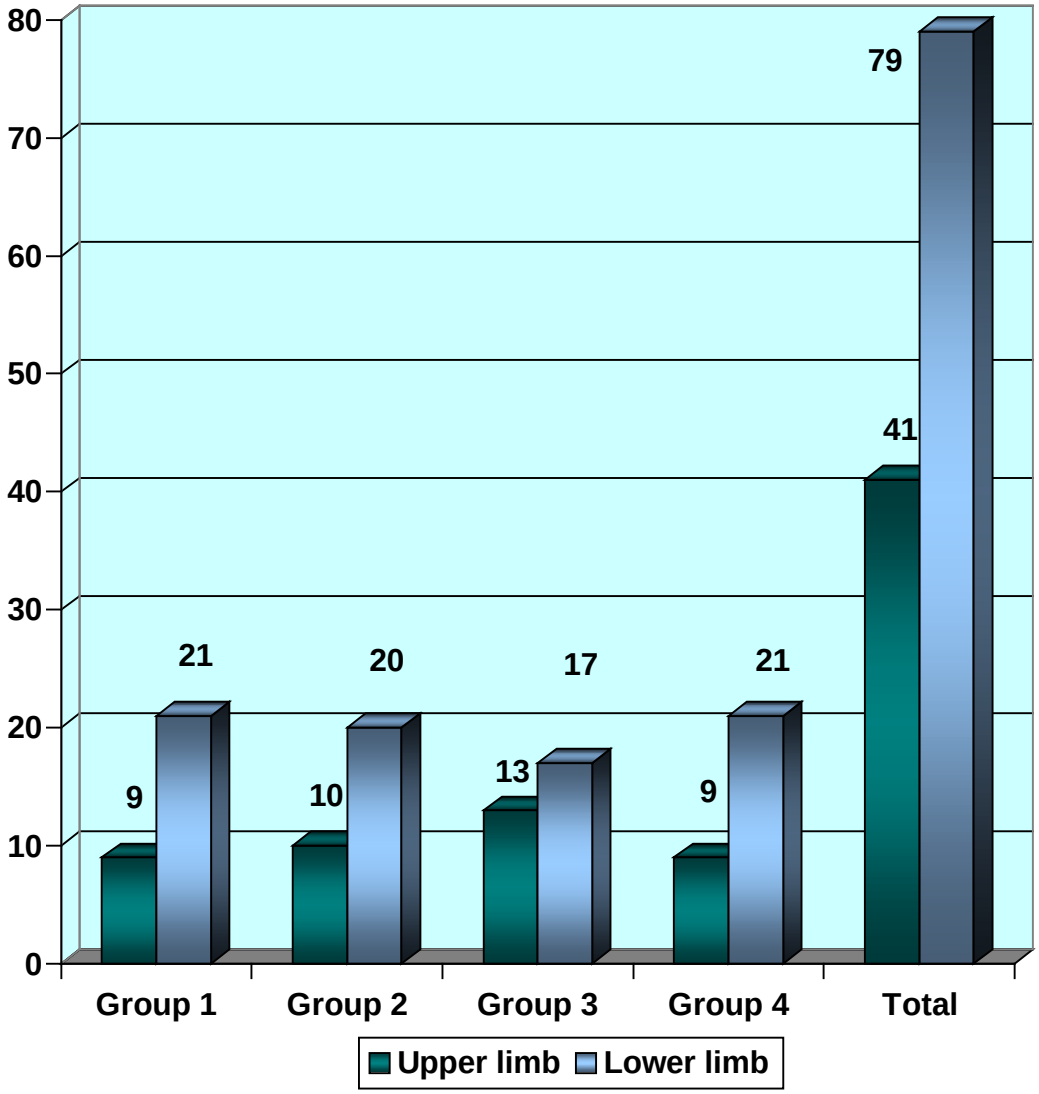
Graph 2 - Age


16
14
12
10
8
6
4
2
0
Group 1
Group 2
Group 3
Group 4
<21
21-30
31-40
41-50
>50

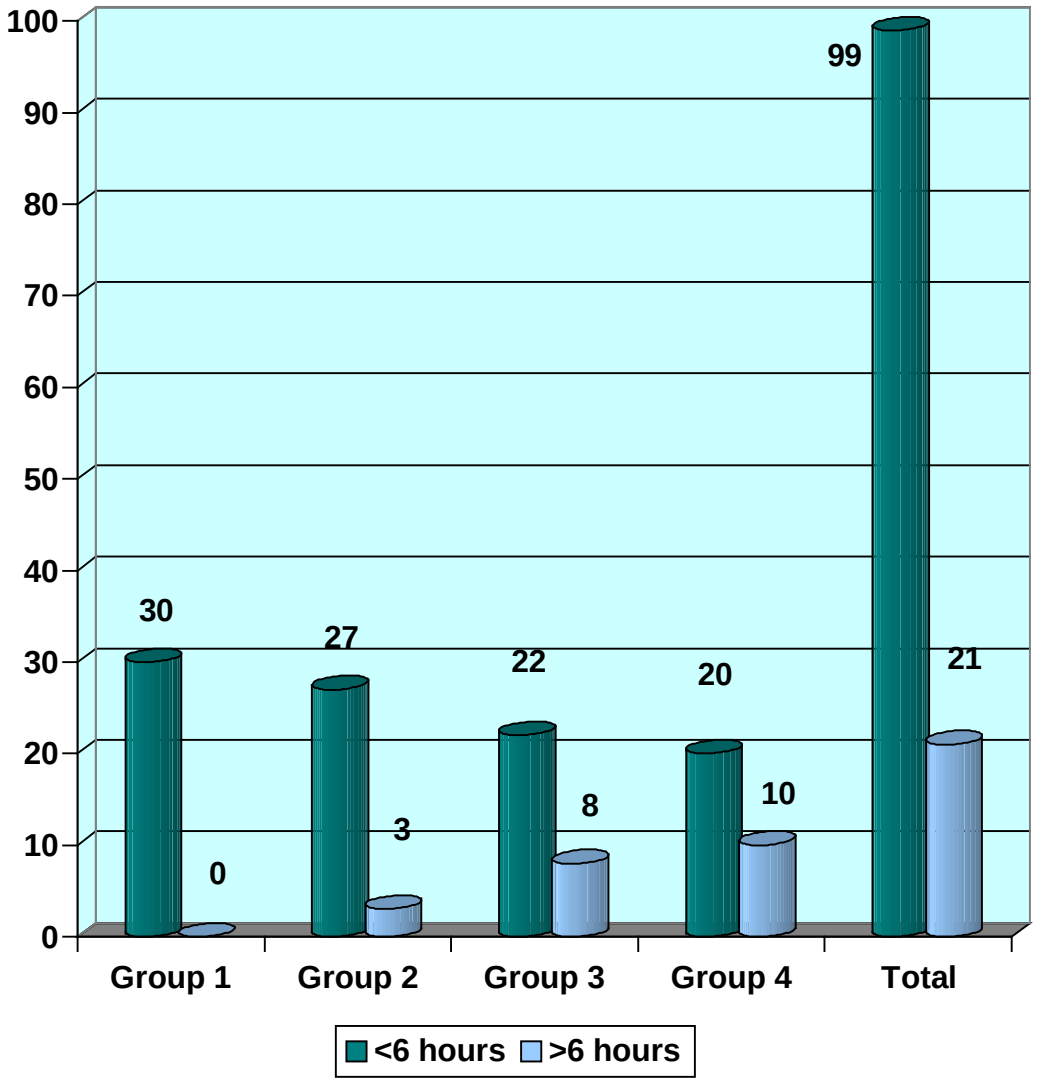
Graph 3 - Sex Distribution



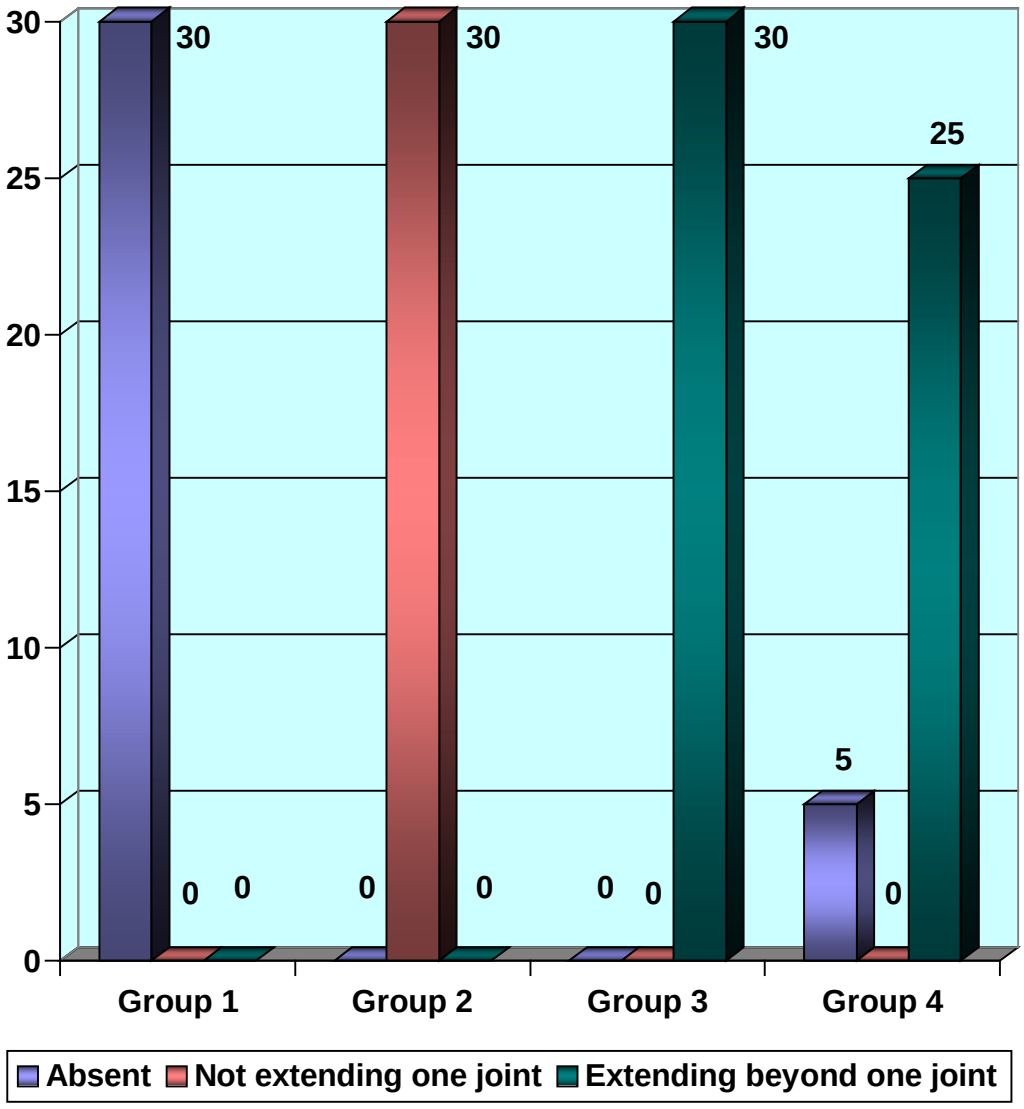
Graph 4 - Site of Snakebite



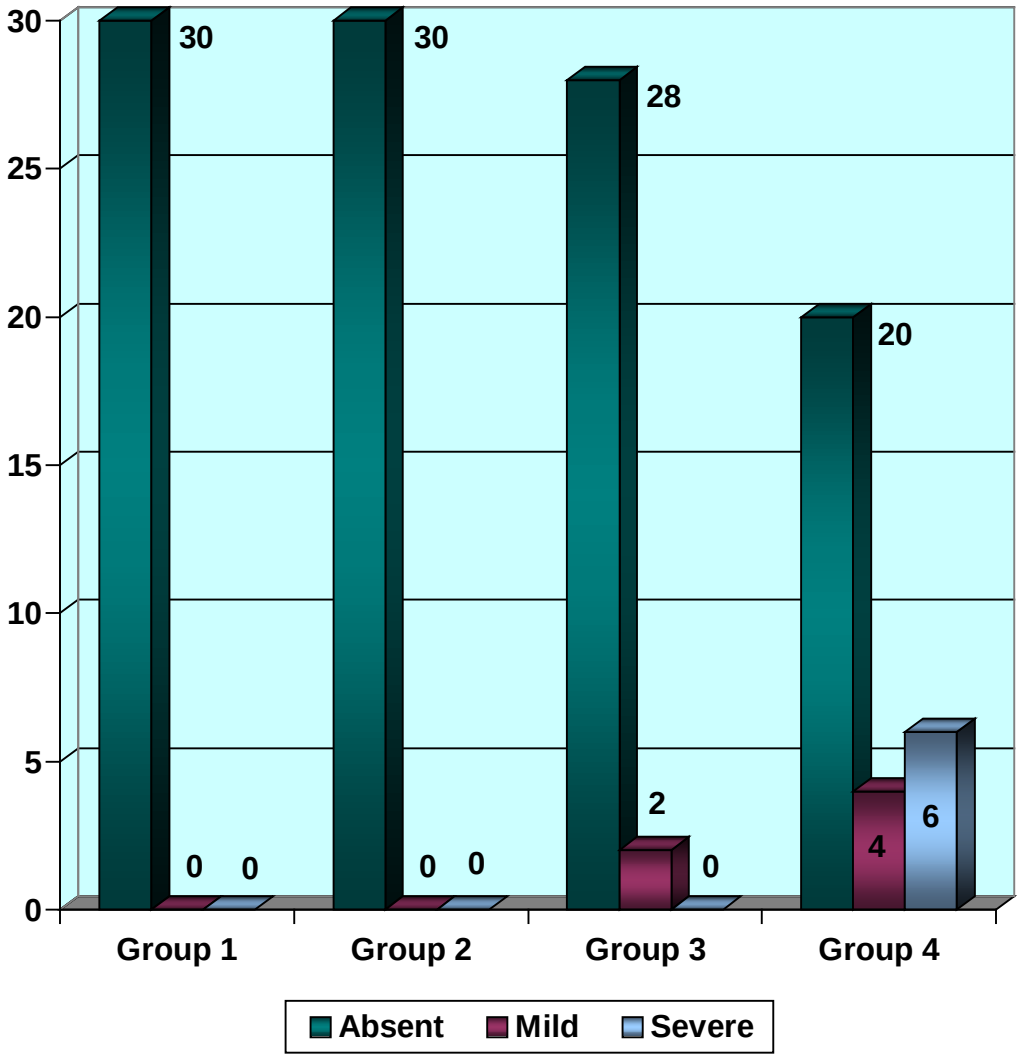
Graph 5 - Time Delay



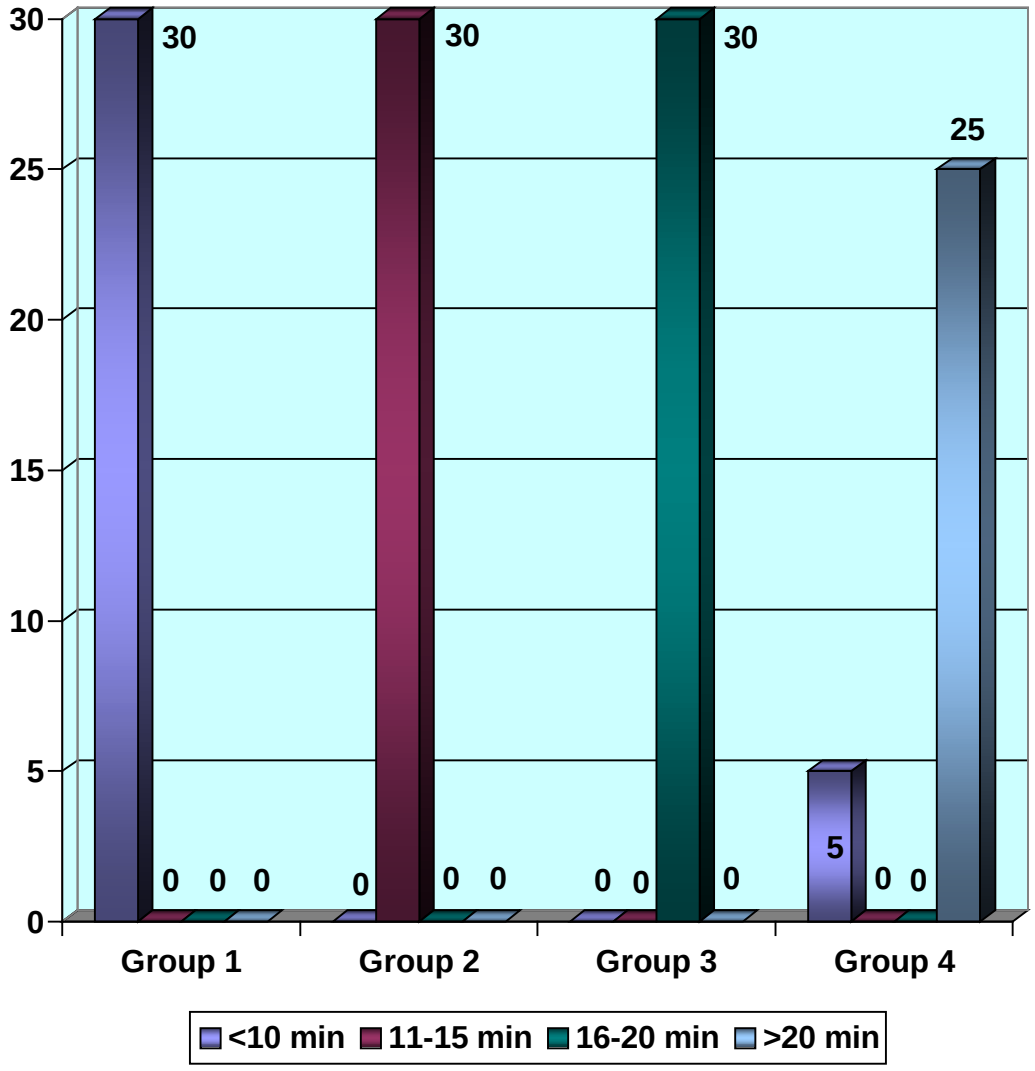
Graph 6 - Local Features



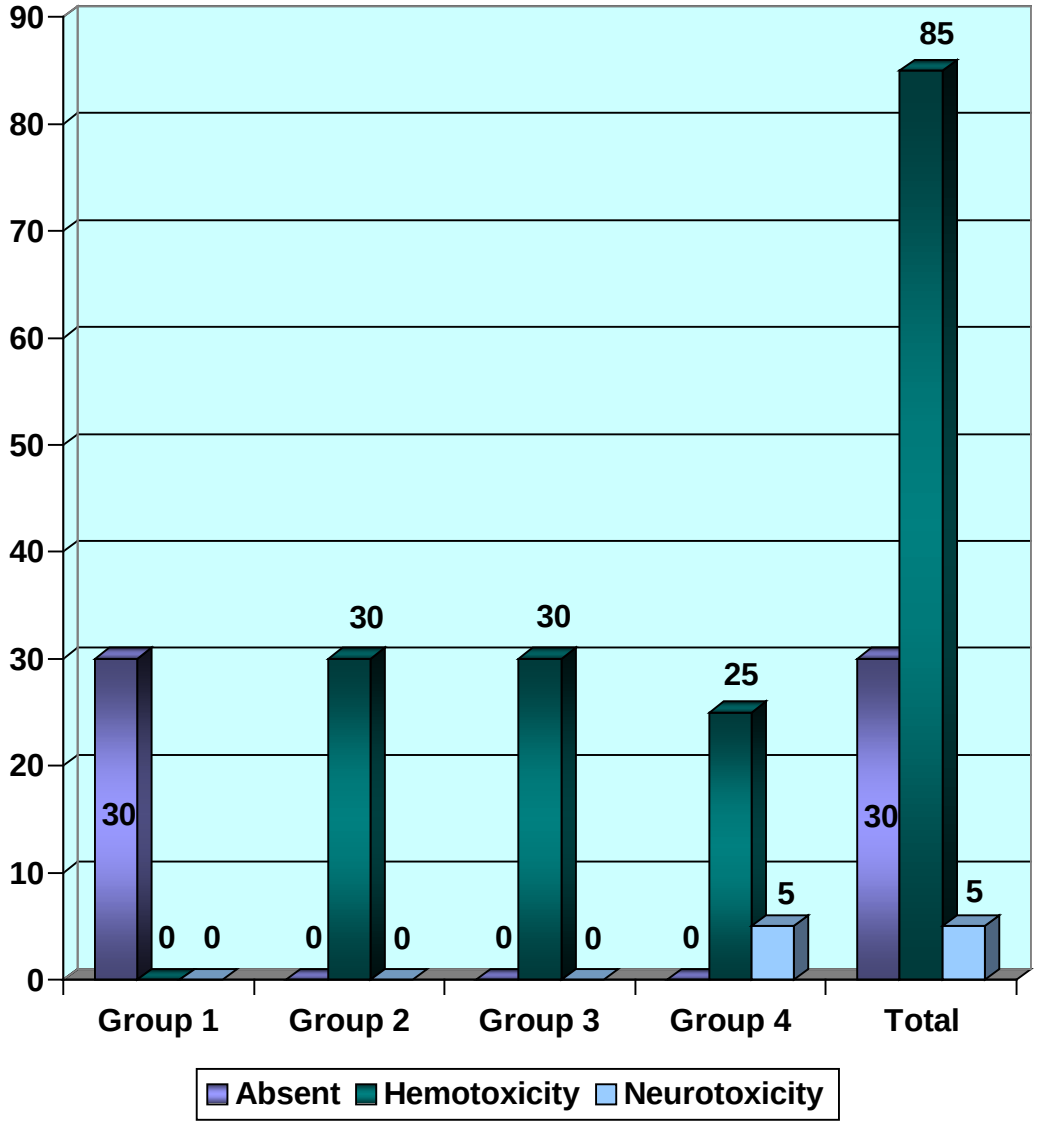
Graph 7 -Systemic Features



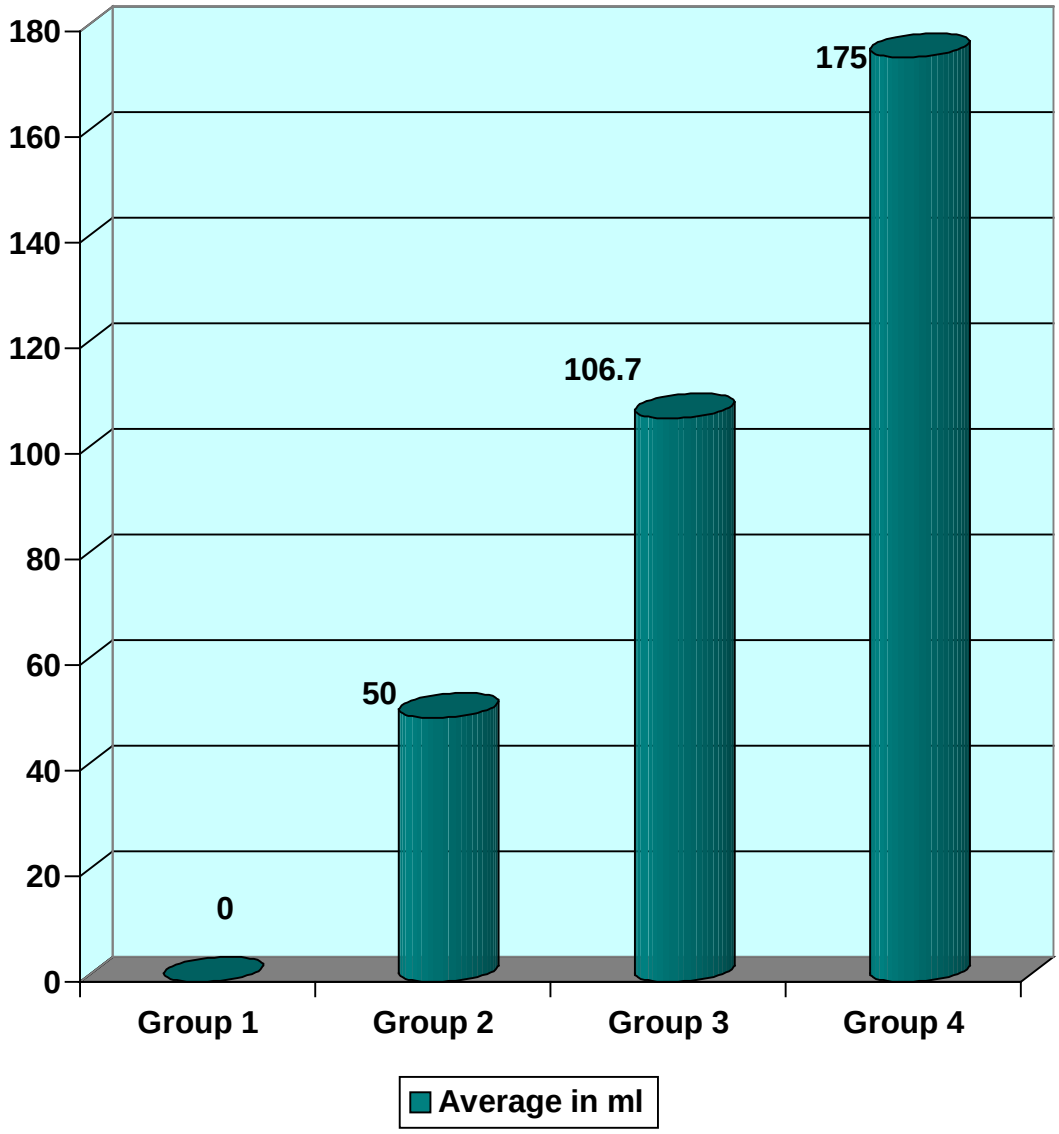
Graph 8 - Clotting Time



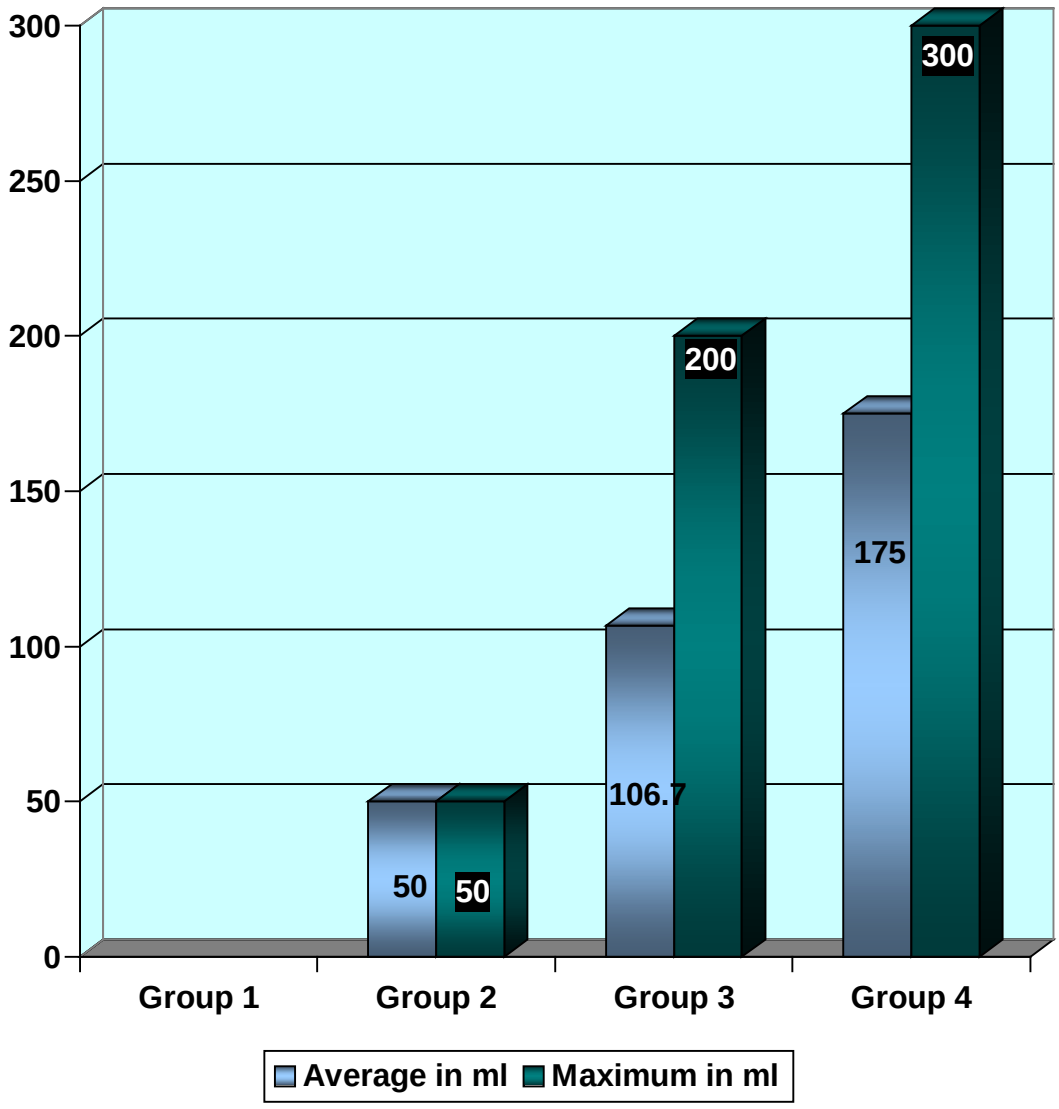
Graph 9 - Toxicity



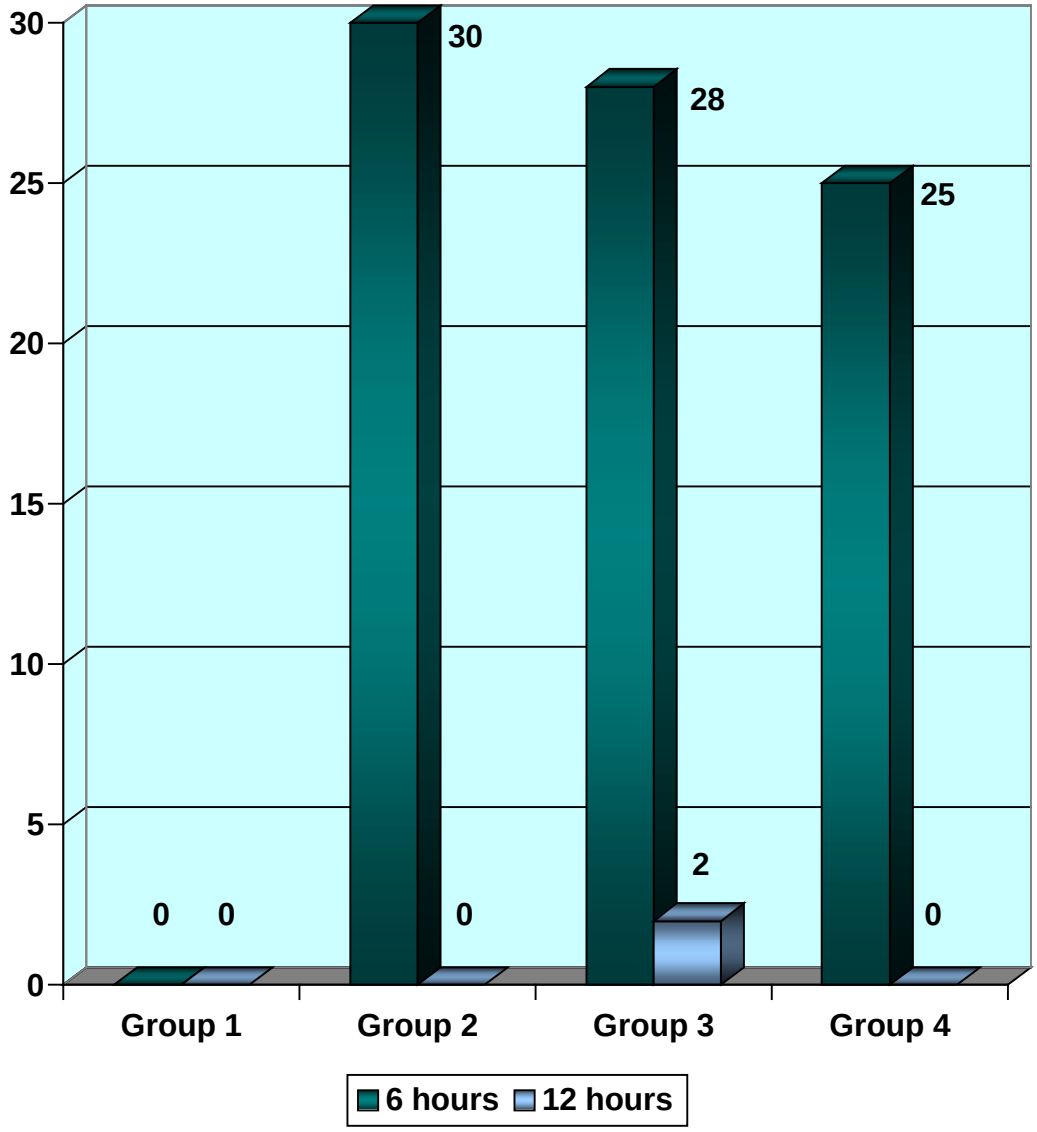
Graph 10: ASV Dose - Average



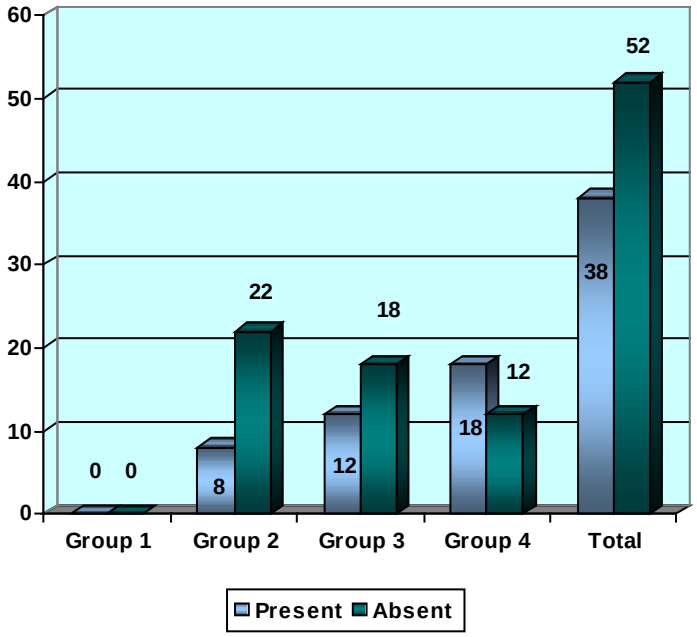
Graph 11: ASV dose - Average & Maximum



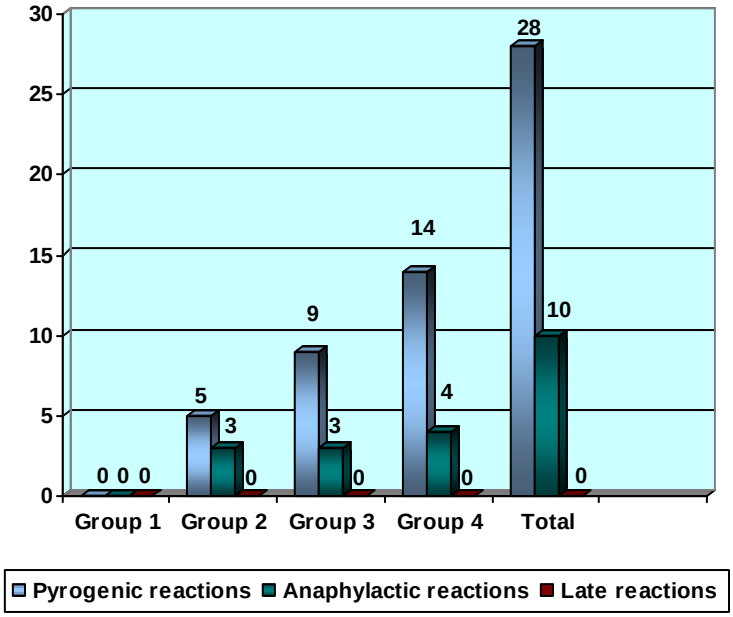
Graph 12 - Clotting time normalisation



Graph 13a - Adverse Effects



Graph 13b Adverse Effects



Graph 14 - Complications