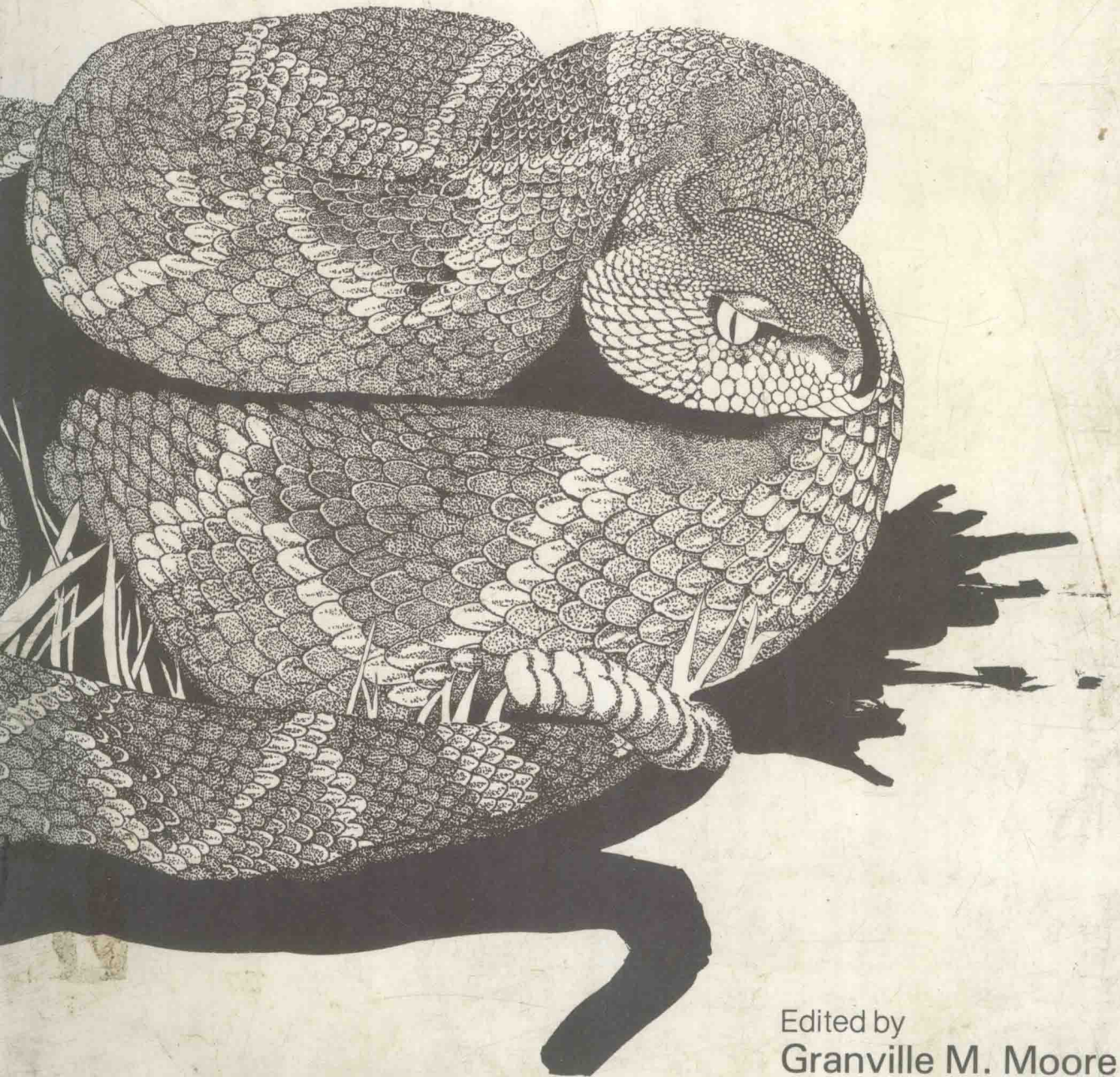


Poisonous Snakes of the World



Edited by
Granville M. Moore

Poisonous Snakes of the World

Editor

Commander Granville M. Moore, MSC, USN



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FOREWORD

The first edition of the ONI 3-62, *Poisonous Snakes of the World*, was published on 30 June 1962 under the auspices of the Office of Naval Intelligence of the Office of the Chief of Naval Operations. The widespread interest generated by this publication and the increasing commitments of Navy and Marine forces throughout the world, particularly in Southeast Asia, have served to emphasize the need for a more authoritative manual that can be used for training and in support of military operations. The Bureau of Medicine and Surgery, having recognized this necessity, assumed the responsibility for a more definitive and comprehensive up-to-date presentation of the problems relating to venomous snakes.

Commander Granville M. Moore, MSC, USN, was appointed as coordinator and principal editor to work with a committee of eminent herpetologists, selected by the American Society of Ichthyologists and Herpetologists, to revise the manual. The Bureau of Medicine and Surgery gratefully acknowledges the important contributions made by this committee and the services provided by the New York Zoological Society.

First aid procedures in cases of snakebite as described herein are approved by the Bureau of Medicine and Surgery and the specific treatment set forth represents the official policy of this Bureau at the time of publication.

This manual is recommended for use by all ships, stations, and commands in need of authoritative information about snakes and snakebites.



R. B. Brown
Vice Admiral, MC
United States Navy
Surgeon General and Chief,
Bureau of Medicine and Surgery

PREFACE

This revision has been made with the assistance of a committee appointed by the American Society of Ichthyologists and Herpetologists. The committee consisted of Dr. Herndon G. Dowling, Dr. Sherman A. Minton, Jr. (chairman), and Dr. Findlay E. Russell. The text has been largely rewritten, however, many of the original illustrations have been retained.

This manual is intended to serve as a training aid and as an identification guide to the most widely distributed species of dangerously venomous snakes. Geographic distribution of all currently recognized species of venomous snakes is presented in tabular form. Information on habitat and biology of important snake species has been provided.

First aid procedures in case of snakebite and suggestions for the definitive medical management of the snakebite victim are presented. There is a table of world sources of antivenins.

The manuscript for the text of this manual was submitted for publication on 1 November 1965. A few additions have been made during the editing and proofreading of the text but most of the included information is as of the date of submission.

ACKNOWLEDGMENTS

The assistance and advice of the following is acknowledged: C.A. Ahuga, Steven C. Anderson, H.D. Baernstein, Charles M. Bogert, F.W. Buess, W. Leslie Burger, Roger Conant, Carl Gans, Joseph F. Gennaro Jr., Itzhak Gilboa, Alice C. Grandison, Laurence M. Klauber, Robert E. Kuntz, Alan E. Leviton, Hymen Marx, Samuel B. McDowell, K.A.C. Powell, George B. Rabb, H. Alistair Reid, Janis A. Roze, the late F.A. Shannon, Harold Voris, John E. Werler, and Eric Worrell.

Personnel of the Medical Photography Division, Naval Medical School, National Naval Medical Center, prepared most of the line illustrations and furnished some of the photographs. Dr. T.E. Reed, Director of the National Zoological Park, kindly made available certain specimens for photography. The index was prepared by Itzhak Gilboa.

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* To facilitate use of this chapter as a reference work, a separate table of contents has been provided.

** To facilitate use of this chapter as a reference work, separate tables of contents have been provided and placed at the beginning of each geographic section.

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Chapter I

GENERAL INFORMATION

Personnel of the U.S. Navy and Marine Corps may find themselves stationed or visiting in many parts of the world, particularly the countries bordering the oceans. In some of these countries, snakebite is a significant public health hazard. The risk of being bitten increases during amphibious operations, especially in tropical and subtropical regions. During such operations the natural habitat of venomous snakes may be disturbed so that exposure to them is markedly increased.

American military forces have never experienced casualty rates from snake venom poisoning sufficiently high to jeopardize the outcome of an operation. However, the threat of snakebite may create a morale problem sufficient to delay an operation or cause unnecessary fear during its execution. While snakebite has been rare and fatalities therefrom have been even more uncommon in the military forces, it does constitute a medical emergency requiring immediate attention and considerable judgment in management.

This manual is designed to facilitate identification of the major groups (genera) of poisonous snakes and to identify the most dangerous species. It is not practical to by-pass the specialized terminology of herpetology completely, but herpetological terms are avoided whenever possible.

Those that are used are defined in the glossary or are evident from examination of the figures.

Geographic definitions of regions discussed are provided because of differences in the use of such words as *Middle East*, *Southeast Asia*, *Near East*, *et cetera*. Snakes found in more than one region are listed in each.

A second aim of the manual is to give suggestions for preventing snakebite, and a third aim is to indicate practical first aid measures should snakebite occur. Principles and procedures for medical management of snake venom poisoning are discussed, but it is not a purpose of this manual to evaluate all of the varied and sometimes conflicting therapeutic regimens that have appeared in the medical literature.

A list of general references is included at the end of the manual, and most chapters and sections are followed by a list of specific references. A space for notes will be found at the end of most chapters and sections. This may be used for additional references and information gained under local conditions.

The index has been prepared as a major source of information. Many local or vernacular names are found *only* in the index, where they are referred to the scientific name of the species.

Chapter II

PRECAUTIONS TO AVOID SNAKEBITE

The best way to keep from being bitten by snakes is to avoid them. However, since there is little choice in a duty assignment, there are certain precautions to be taken in "snake country." In such areas it is advisable to carry a snakebite first aid kit. Snakebite Kit, Suction (FSN 6545-952-5325), may be ordered through the Armed Forces Supply Agency. When such kits are not available, the following items can be substituted: an antiseptic, a razor or sharp knife, a piece of rubber tubing or similar item to be used as a tourniquet, and any device capable of providing suction. A 10 ml. syringe with needle, a vial of physiologic saline and two vials of adrenalin should also be carried for use in administering horse serum sensitivity tests (see p. 16).

Reminders

When in snake infested country it is important to:

1. *Remember that snakes are probably more afraid of humans than humans are of snakes.* Given the chance snakes will usually retreat to avoid an encounter.

2. *Learn to recognize the poisonous snakes in the area of operation.* Avoid killing harmless snakes.

3. *Avoid walking around after dark.* Many venomous snakes are nocturnal and will travel at night far beyond the distances they may venture during the day. If you must walk at night be sure to wear boots.

4. *Remember that snakes in general avoid di-*

rect sunlight, and that they are most active at moderate temperatures.

5. *Avoid caves, open tombs, and known snake den areas.* Snakes live in areas which afford protection and which may be frequented by other small animals. They may be found in considerable numbers in caves and open tombs during the hibernation period which in most snakes extends from fall until early spring. They may also seek out these same areas during the summer months.

6. *Remember that poisonous snakes may be found at high altitudes*, and that they can climb trees and fences.

7. *Walk on clear paths as much as possible.* Avoid tall grass and areas of heavy underbrush or ground covering. Wear protective clothing when entering such areas.

8. *Avoid swimming in waters where snakes abound.* Most land species of poisonous snakes swim well, and may, under unusual circumstances, bite while in water. Sea snakes are not uncommon in the Indo-Pacific area, and while most species are docile some may bite when handled or disturbed.

9. *Avoid sleeping on the ground whenever possible.*

10. *Avoid walking close to rocky ledges.* Give snakes a wide passage, just in case.

11. *Avoid hiking alone in snake-infested areas.*

12. *Avoid horse-play involving live or dead snakes.* Snakes should not be handled carelessly. Teasing people with snakes may have unexpected and unfortunate results.

Specific Precautions

The following *DON'Ts* are suggested for those in snake country.

1. DON'T put your hands or feet in places you can not look, and

DON'T put them in places without first looking.

2. DON'T turn or lift a rock or fallen tree with your hands. Move it with a stick, or with your foot if your ankle and leg are properly protected.

3. DON'T disturb snakes.

4. DON'T put your sleeping bag near rock piles or rubbish piles or near the entrance to a cave.

5. DON'T sit down without first looking around carefully.

6. DON'T gather firewood after dark.

7. DON'T step over a log if the other side is not visible. Step on it first.

8. DON'T enter snake-infested areas without adequate protective clothing.

9. DON'T handle freshly killed venomous snakes. Always carry them on a stick or in a bag if they must be returned to the command post.

10. DON'T crawl under a fence in high grass, or in an uncleared area.

11. DON'T go out of your way to kill a snake. Thousands of people are bitten by snakes each year merely because they try to kill them without knowing anything of their habits or habitats.

12. Finally, DON'T PANIC!

NOTES

Chapter III

HOW TO RECOGNIZE SNAKE VENOM POISONING

Symptoms and Signs

INTRODUCTION

In most parts of the world, bites by nonvenomous snakes occur far more frequently than bites by venomous snakes. Since the differentiation is often difficult, all victims of snakebite should be brought under the care of a physician as quickly as possible. Whenever feasible the offending snake should be killed and brought with the victim to the physician or person charged with the responsibility of identifying the reptile.

While it is not always possible to identify the snake responsible for the bite by the tooth or fang marks found on the victim's skin, in some cases these may be of considerable value in differentiating between bites by venomous and nonvenomous species. Bites by the vipers (Old World vipers, pit vipers of Asia, eastern Europe, and the rattlesnakes and related species of the Americas) usually result in one or two relatively large puncture wounds of varying depth, depending on the size of the snake, the force of its strike, and other factors. In most cases, additional tooth marks are not seen. Bites by the elapid snakes (cobras, mambas, tiger snake, taipan, coral snakes and related species) usually produce one or two small puncture wounds, although occasionally there may be one or two additional punctures. Sea snake bites are characterized by multiple (2 to 20) pinhead-sized puncture wounds. In some cases the teeth may be broken off and remain in the wound.

Proper identification of fang or tooth marks may be complicated in those cases where skin tears result from jerking an extremity away during the biting act. This is a particular problem in viper bites where long scratches or even lacerations

are inflicted by the fangs. In bites by elapid snakes there may be superficial scratches from the snake's mandibular and palatine teeth. Thus, it can be seen that while fang or tooth patterns may be of assistance in determining the identity of an offending snake, they should not be depended upon as the deciding factor in establishing the diagnosis.

It should be noted that *one can be bitten by a venomous snake and not be poisoned*. In 3 to 40 per cent of the bites inflicted by venomous snakes, no signs or symptoms of poisoning develop. This may be due to the fact that the snake does not always eject venom or, if venom is ejected, that it does not enter the wound, as can sometimes happen in very superficial bites. This important fact should always be considered before specific treatment is started.

Venom Apparatus

The venom apparatus of a snake consists of a gland, a duct, and one or more fangs located on each side of the head (fig. 1). The size of these structures depends on the size and species of the snake. Each venom gland is invested in a connective tissue sheath which is invaded by the muscles that contract it during discharge of the venom. The innervation of these muscles is different from that controlling the biting mechanisms; thus, the snake can control the amount of venom it ejects. It can discharge venom from either fang, from both, or from neither. Snakes rarely eject the full contents of their glands.

Most rattlesnakes probably discharge between 25 and 75 percent of their venom when they bite

a human. The true vipers discharge about the same, perhaps slightly less. There appears to be a greater variation in the amount an elapid may discharge. Many victims of elapid venom poisoning have minimal signs and symptoms; others show evidence of severe poisoning.

The fangs of the vipers are two elongated, canaliculated teeth of the maxillary bones. These bones can be rotated so that the fangs can be moved from their resting positions against the upper jaw, to their biting positions, approximately perpendicular to the upper jaw. These snakes have full control over their fangs, raising or lowering them at will as when striking, biting, or yawning. The two functional fangs are shed periodically and are replaced by the first reserve fangs. The fangs of the elapid snakes are two enlarged anterior maxillary teeth. These teeth are hollow and are fixed in an erect position.

Snake Venoms

The venom of most snakes is a complex mix-

ture, chiefly proteins, many of which have enzymatic activity. Some of the effects of snake venoms are due to the nonenzymatic protein portions of the venom, while others are due to the enzymes and enzymatic combinations. The symptoms and signs of snake venom poisoning may be complicated by the release of several substances from the victim's own tissues. These autopharmacologic substances sometimes render diagnosis and treatment more difficult.

The arbitrary division of venoms into such groups as *neurotoxins*, *hemotoxins*, and *cardiotoxins*, while having some useful purpose in classification, has led to much misunderstanding and a number of errors in treatment. It has become increasingly apparent that these divisions are over-simplified and misleading. Neurotoxins can, and often do, have cardiotoxic or hemotoxic activity, or both; cardiotoxins may have neurotoxic or hemotoxic activity, or both; and hemotoxins may have the other activities. It is best to consider *all* snake venoms capable of producing several changes, sometimes concomitantly, in one

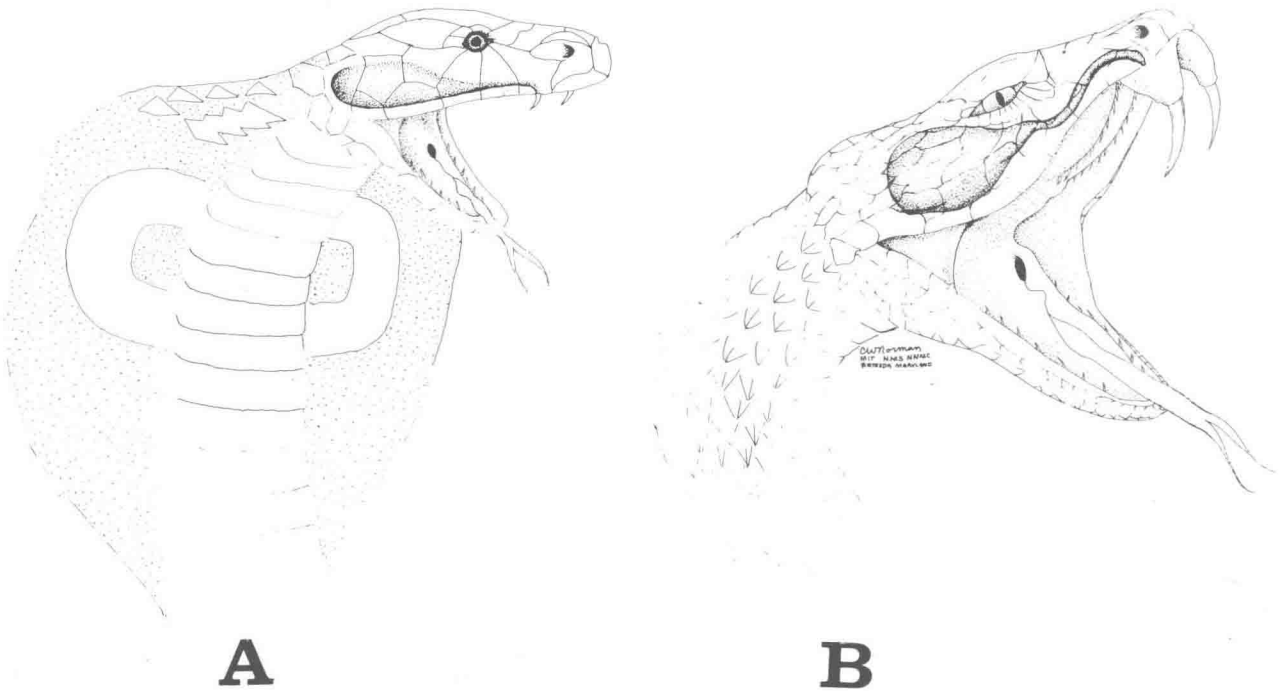


FIGURE 1.—Figures of fangs, venom ducts, and venom glands of: A. Cobra (Elapidae), and B. Viper (Viperidae). The fangs of elapid snakes are much shorter than those of vipers and do not rotate. In each case the venom glands lie outside the main jaw muscles toward the back of the head. The venom ducts lead from the glands to the bases of the hollow fangs.

TABLE 1.—YIELD AND LETHALITY OF VENOMS OF IMPORTANT POISONOUS SNAKES

Snake	Average length of adult (inches)	Approximate yield, dry venom (mg.)	Intraperitoneal LD ₅₀ (mg./kg.)	Intravenous LD ₅₀ (mg./kg.)
North America				
A. Rattlesnakes (<i>Crotalus</i>)				
Eastern diamondback (<i>C. adamanteus</i>)	33-65	370-720	1.89	1.68
Western diamondback (<i>C. atrox</i>)	30-65	175-325	3.71	4.20
Timber (<i>C. horridus horridus</i>)	32-54	95-150	2.91	2.63
Prairie (<i>C. viridis viridis</i>)	32-46	25-100	2.25	1.61
Great Basin (<i>C. v. lutosus</i>)	32-46	75-150	2.20	—
Southern Pacific (<i>C. v. helleri</i>)	30-48	75-160	1.60	1.29
Red diamond (<i>C. ruber ruber</i>)	30-52	125-400	6.69	3.70
Mojave (<i>C. scutulatus</i>)	22-40	50-90	0.23	0.21
Sidewinder (<i>C. cerastes</i>)	18-30	18-40	4.00	—
B. Moccasins (<i>Agkistrodon</i>)				
Cottonmouth (<i>A. piscivorus</i>)	30-50	90-148	5.11	4.00
Copperhead (<i>A. contortrix</i>)	24-36	40-72	10.50	10.92
Cantil (<i>A. bilineatus</i>)	30-42	50-95	—	2.40
C. Coral snakes (<i>Micrurus</i>)				
Eastern coral snake (<i>M. fulvius</i>)	16-28	2-6	0.97	—
Central and South America				
A. Rattlesnakes (<i>Crotalus</i>)				
Cascabel (<i>C. durissus terrificus</i>)	20-48	20-40	0.30	—
B. American lance-headed vipers (<i>Bothrops</i>)				
Barba amarilla (<i>B. atrox</i>)	46-80	70-160	3.80	4.27
C. Bushmaster (<i>Lachesis mutus</i>)	70-110	280-450	5.93	—
Asia				
A. Cobras (<i>Naja</i>)				
Asian cobra (<i>N. naja</i>)	45-65	170-325	0.40	0.40
B. Kraits (<i>Bungarus</i>)				
Indian krait (<i>B. caeruleus</i>)	36-48	8-20	—	0.09
C. Vipers (<i>Vipera</i>)				
Russell's viper (<i>V. russelii</i>)	40-50	130-250	—	0.08
D. Pit vipers (<i>Agkistrodon</i>)				
Malayan pit viper (<i>A. rhodostoma</i>)	25-35	40-60	—	6.20
Africa				
A. Vipers				
Puff adder (<i>Bitis arietans</i>)	30-48	130-200	3.68	—
Saw-scaled viper (<i>Echis carinatus</i>)	16-22	20-35	—	2.30
B. Mambas (<i>Dendroaspis</i>)				
Eastern green mamba (<i>D. angusticeps</i>)	50-72	60-95	—	0.45
Australia				
A. Tiger snake (<i>Notechis scutatus</i>)	30-56	30-70	0.04	—
Europe				
A. Vipers				
European viper (<i>Vipera berus</i>)	18-24	6-18	0.80	0.55
Indo-Pacific				
A. Sea snakes				
Beaked sea snake (<i>Enhydrina schistosa</i>)	30-48	7-20	—	0.01

or more of the organ systems of the body.

It is also apparent that quantitative and, perhaps, qualitative differences in the chemistry of venoms may occur at the species level and may, in fact, be evident in snakes of the same species taken from different geographic areas. Thus, differences in the symptoms and signs of poisoning may occur even when similar snakes are involved in a series of accidents.

In Table 1 are given the names of some of the more important venomous snakes of the world, their adult average lengths, the approximate amount of dried venom contained within their venom glands (adult specimens), and the intraperitoneal and intravenous LD₅₀ in mice, as expressed in milligrams of venom (on a dry weight basis) per kilogram of test animal body weight. The purpose of this table is to demonstrate the considerable differences that exist in the lethality of various snake venoms.

In general, the venoms of the vipers cause deleterious changes in the tissues both at the site of the bite and in its proximity, changes in the red blood cells, defects in coagulation, injury to the blood vessels; and, to a lesser extent, damage to the heart muscle, kidneys, and lungs. The venom of the tropical rattlesnake, *Crotalus durissus*, causes more severe changes in nerve conduction and neuromuscular transmission than do other crotalid venoms. The venoms of the elapid snakes cause lesser local tissue changes, but often cause serious alterations in sensory and motor function as well as cardiac and respiratory difficulties.

SYMPTOMS AND SIGNS

The symptoms, signs, and the gravity of snake venom poisoning are dependent upon a number of factors: the age and size of the victim, the nature, location, depth, and number of bites, the length of time the snake holds on, the extent of anger or fear that motivates the snake to strike, the amount of venom injected, the species and size of the snake involved, the condition of its fangs and venom glands, the victim's sensitivity to the venom, the pathogens present in the snake's mouth, and the degree and kind of first aid and subsequent medical care. It can be seen that

snakebites may vary in severity from trivial to extremely grave.

The findings given in tables 2, 3, and 4 are those observed in what may be termed typical, moderately severe cases of snake venom poisoning. While they are not complete, they do provide a ready reference of the more commonly observed sequelae of bites by venomous snakes.

Diagnosis of crotalid envenomation is dependent upon the presence of one or more fang marks, and immediate and usually progressive swelling, edema, and pain. In most cases swelling and edema are constant findings and are usually seen about the injured area within 10 minutes of the bite. In the absence of treatment, the swelling progresses rapidly and may involve the entire injured extremity within one hour. Generally, however, swelling and edema spread more slowly, and usually over a period of 8 to 36 hours. Swelling and edema are most marked following bites by the North American rattlesnakes (excluding the Mojave, massasaugas, and pigmy rattlesnakes) and the American lance-headed vipers (*Bothrops*). Swelling is slightly less marked following bites by the Malayan pit viper (*Agkistrodon rhodostoma*) and related species, the Asian lance-headed vipers (*Trimeresurus*), and the American moccasins (*Agkistrodon*). It is least acute following bites by the cascabel (*Crotalus durissus terrificus*).

In many cases, discoloration of the skin and ecchymosis appear in the area of the bite within several hours. The skin appears tense and shiny. Vesicles may form within 3 hours, and are generally present by the end of 24 hours. Hemorrhagic vesiculations and petechiae are common.

Pain immediately following the bite is a common complaint in most cases of crotalid poisoning. It is most severe following bites by the South American pit vipers (except for the cascabel, which is less severe); the eastern diamondback, western diamondback, and timber rattlesnakes of North America, and the Asian lance-headed vipers.

Weakness, sweating, faintness, and nausea are commonly reported. Regional lymph nodes may be enlarged, painful, and tender. A very common complaint following bites by some rattlesnakes, and one sometimes reported following other pit viper bites, is tingling or numbness over

TABLE 2.—SYMPTOMS AND SIGNS OF CROTALID BITES

Symptoms and Signs ¹	North American Rattlesnakes (<i>Crotalus</i>)	Central and South American Rattlesnakes (<i>Crotalus</i>)	North American Moccasins (<i>Agkistrodon</i>)	American Lance- headed Vipers (<i>Bothrops</i>)	Asian Lance- headed Vipers (<i>Trimeresurus</i>)	Malayan Pit Viper (<i>Agkistrodon</i>)
Swelling and edema-----	+++ ⁶	+	++	+++	++	++
Pain-----	++	++	+	+++	++	++
Discoloration of skin-----	+++	+	+	+++	++	++
Vesicles-----	+++		+	+++	++	++
Echymosis-----	+++	+	++	+++	++	++
Superficial thrombosis-----	++		-	++	-	-
Necrosis-----	++		+	+++	+	+
Sloughing of tissue-----	++		-	+++	+	+
Weakness-----	++	++	+	+++	++	++
Thirst-----	++	++	+	+++	+	++
Nausea or vomiting or both-----	++	++	+	+++	-	-
Diarrhea-----	+	++	+	++	+	++
Weak pulse and changes in rate-----	+++	+++	-	+++	++	++
Hypotension or shock-----	+++	+	+	+++	++	++
Sphering or destruction of red blood cells-----	+++	-	-	+++	-	-
Increased bleeding time-----	++	+	-	++	+	+
Increased clotting time-----	+++	+	-	++	++	++
Hemorrhage ² -----	+++	-	+	+++	++	++
Anemia-----	++	-	-	++	+	+
Blood platelet changes ³ -----	++	-	-	++	+	+
Glycosuria-----	++	-	+	++	-	-
Proteinuria-----	++	+	+	++	+	+
Tingling or numbness ⁴ -----	++	++	+	++	+	+
Fasciculations-----	+	++	-	++	-	-
Muscular weakness or paralysis-----	+	+++	-	+	-	-
Ptosis-----	+	++	-	+	-	-
Blurring of vision-----	+	+++	-	+	-	-
Respiratory distress-----	++	+++	-	++	-	-
Swelling regional lymph nodes-----	++	+	+	++	+	+
Abnormal ECG-----	+	++	-	++	++	++
Coma-----	+	++	-	+	+	+

¹ In the more severe cases the intensity of the symptoms and signs may be markedly increased. In addition, there may be severe respiratory distress, cyanosis, muscle spasms, and secondary shock leading to death.

² Bleeding may be from the gastrointestinal, urinary, or respiratory tracts, from the gums, or it may be subcutaneous. In *Trimeresurus* bites the hemorrhage is usually confined to the locus of the wound. Bleeding from the gums is common following *Bothrops* envenomation.

³ Platelets may be increased in mild poisonings and markedly decreased in severe cases.

⁴ Often confined to the tongue and mouth, but may involve the scalp and distal parts of the toes and fingers as well as the injured part.

⁶(+ to +++) = Grading of severity of symptom, sign or finding, (-) = Of lesser significance or absent, () = Information lacking.