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## The Epidemiology of Rattlesnake Envenomation in Tucson, Arizona: 1973 - 1980 - A Preliminary Report

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Significant numbers of rattlesnake bite victims are treated each year in Tucson, Arizona. However, there has been little information available on the experience of the medical community with this group or patients.

A retrospective study was made of the medical records of 159 Patients admitted to the eight general hospitals in Tucson with the diagnosis of rattlesnake bite during the years 1973 to 1980. Information from individual records was recorded onto a data form by the author and then transferred to a mark sense score card. The cards were processed by optical scanner and a Digital Equipment Corporation DECsystem-10 computer. The initial descriptive frequency distribution printout serves as the basis for this report.

The study group was composed of 127 males and 32 females ranging in age from 2 - 81 years with 67% in the 11 - 40 year age group. Most were bitten (91%) during the warmer months of April through October with peaks in May (15%), August (18%), and September (23%). Usually bites occurred near home, either outside (36%) or inside (16%), or in the desert valleys and foothills (18%). Only 2 (1.3%) victims were in mountains. The upper extremity was involved in 64% and lower in 35% with fingers most common (54%). All bites in females were 'legitimate' (exposure to being bitten unintentional), while in males 'illegitimate' bites (unnecessary exposure to being bitten because of rattlesnake manipulation) predominated (55%) over those that were 'legitimate' (45%). Based upon the habitat and elevation of the involved snake's origin and those reliably identified, It is estimated that most bites are inflicted by the western diamondback rattlesnake, *Crotalus atrox* (60%), or the Mojave rattlesnake, *C.s. scutulatus* (30%). Snakes 23 - 46 cm in length were involved in 71 (62%) of the 115 instances where length was stated.

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**First aid measures\* used by victims are as-follows (some used more than one measure):**

Constrictive band	37	(55%)	.	.
Ice	23	(34%)	.	.
Incision, oral suction	17	(25%)	.	.
Oral suction, punctures	16	(24%)	.	.
Puncture site squeezed	5	(8%)	N=70	(44%)
Incision only	3	(51%)	.	.
Snakebite kit (Cutter)	3	(5%)	.	.
Unknown	3	(5%)	.	.
None	89	(56%)	.	.

\* None of these measures are necessarily recommended.

**Hospital treatment, patient's course and complications are summarized below:  
(Emergency room care: Tucson hospitals only. Some received more than one modality)**

Antivenin (AV)	59	(58%)	.	.
Incision and suction	43	(43%)	.	.
Ice	26	(25%)	.	.
Constrictive band	24	(24%)	N=101	(64%)
Steroids, primary treatment	12	(12%)	.	.
Suction only	8	(8%)	.	.
Excision of bite area	4	(4%)	.	.
None	58	(36%)	.	.

**WYETH Antivenin (Crotalidae) Polyvalent was used in 98 (62%) patients, primarily by intravenous route, in the following amounts:**

1-2 vials	25	(25%)	}	.
3-5 vials	40	(40%)	}	Average for 97
6-10 vials	25	(25%)	}	patients = 5.1
12-21 vials	7	(7%)	}	vials
51 vials	1	(1%)	}	.
.	.	.	.	.
No AV given	62	(38%)	.	.

**Acute serum reactions:**

Severity				Signs			
Mild	10	}	.	Hives	13	}	.
Moderate	5	}	17%	Swelling, face & tongue	4	}	N=17
Severe	2	}	.	Hypotension	3	}	.
	.	.	.	Asthma	2	}	.
None reported	81	.	84%		.	.	.

**Delayed Serum reactions:**

Present	21	(21%)
None	8	(8%)
Unknown	69	(70%)

**Other medical therapy:**

Ice bags	106	(67%)
Steroids, primary treatment	16	(10%)
Blood products (FFP, platelets, cryp-ppt, packed rbc's)	5	(4%)
Antibiotics	66	(42%)
Heparin	1	(.6%)

**Surgical treatment:**

Excision	5	}	.	.
Fasciotomy	3	}	N=7	(4%)
No surgery	.	.	152	(96%)

**Maximum Swelling:**

None	11	(7%)
Minimum (confined to area of bite)	32	(20%)
Moderate (1/3 to 2/3 of extremity)	50	(31%)
Maximum (entire extremity or head)	66	(42%)

**Hypotension (adult - 80 mmHg systolic BP; pediatric - 60):**

Acute, outlying facility	4	}	8	(5%)
Acute, Tucson facility	4	}	.	.
Delayed (after 2 Hrs)	.	.	0	.

**Hematological abnormalities:**

			Tested
Hemoglobin < 10.0 g/dl and/or hematocrit < 30%	5	(3%)	151
Platelet count < 150,000 cm <sup>3</sup>	29	(23%)	127
Fibrinogen < 150 mg/dl	43	(41%)	106
Fibrin split products > 10 µg/dl	21	(54%)	39

**Signs of significant hemorrhage:**

Ecchymosis	68	(43%)
Persistent bleeding from bite incision	1	(.6%)
Bleeding from venipuncture	1	(.6%)
Systemic bleeding (G.I., renal, CNS)	0	.

**Pulmonary problems:**

Adult respiratory distress syndrome (ARDS) and pleural effusion	1	(.6%)
None reported	158	(99%)

**Neurological problems:**

Perioral tingling or numbness	5	(3%)
Eyelid ptosis	1	(.6%)
None reported	153	(96%)

**Residual effects of envenomation and/or treatment:**

Necrosis	1.0 cm <sup>2</sup> or less (all were fingers)	8	(5%)
Necrosis	1.5 cm <sup>2</sup> (finger)	1	(.6%)
Digital amputation at distal IP joint	.	1	(.6%)
None	.	149	(95%)

**Contractures - Infections:**

Contracture, digit	3	(2%)
Contracture, extremity	0	.
Infection	4	(3%)
Infection with osteomyelitis	2	(1%)

**Hospital days:**

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Average, all patients	3.9 days
Average, patients without fasciotomy	3.4 days
Average, 3 fasciotomy patients (9, 17, 71 days)	32.3 days

**Final grade of bite, i.e. degree of swelling (upgraded one if coagulopathy, contracture, hypotension, infection or necrosis present):**

No envenomation	10	(6%)
Mild	25	(16%)
Moderate	40	(25%)
Severe	84	(53%)

## **Discussion**

Most rattlesnake bites in Tucson and the surrounding area occur during the warmer seven months of April to October and often near the victim's home. The interest in rattlesnakes shown by males results in a high incidence of illegitimate finger envenomation.

Patients were cared for by many different physicians with varying degrees of knowledge and interest concerning *Crotalus* envenomation. The overall results were satisfactory since the average hospital stay was 3.9 days, the incidence of residual effects, i.e., contracture, digital amputation and loss of function was low (2.4%) and there were no fatalities. Based upon local and systemic signs, the final grade of the bite was considered to be moderate or severe in 124 (78%) patients. Since correlations were not included in the initial data process, effects of treatment upon improvement of the patient's clinical course are not available.

Antivenin was administered to 61% of patients and acute serum reactions occurred in 17%, of which 2 (2%) were severe. The incidence of delayed serum reactions (serum sickness) in the study group is not known but is estimated to be 80% in those receiving 50 ml or more. Five patients were readmitted (1 - 3 hospital days) for treatment of such reactions. All serum reactions responded to treatment.

Morbidity was greatly increased in the three patients who underwent fasciotomy, having a total of ten surgical procedures and an average of 32 hospital days. There were 64 patients with massive swelling and 49 with significant swelling or the extremity who did not have this procedure. In this group, none were found who did not recover completely, i.e., without residual effects such as muscle contractures.

Digital contracture occurred in three patients. One was secondary to necrosis and one each following bite excision and fasciotomy.

Necrosis was present in ten (6%) patients, all finger bites, with primary healing in eight. There was one contracture (above) and one digital amputation of the distal phalanx.

Eyelid ptosis was observed in a four year old boy envenomated by an 84 cm Mojave rattlesnake. However, despite a large estimated number of envenomations by *C. s. scutulatus*, no patient was reported as having dysphagia, dysphonia, diplopia or muscle weakness indicative of venom effects on neuromuscular



transmission.

Eight (5%) patients were found to be hypotensive when first admitted to a medical facility and all responded to rapid intravenous infusion of crystalloid solution. Hypotension did not occur later in the hospital course in any patient, perhaps due to the judicious use of i.v. fluid therapy in preventing hypovolemia.

When appropriate laboratory studies were available, coagulation factors were frequently abnormal. However, none of the patients had signs of systemic bleeding (renal, G.I., or CNS). Five patients had the hemoglobin fall below 10.0 g/dl, four secondary to extensive ecchymosis and one to persistent bleeding from incision site. Two were given packed red blood cells.

### **Conclusions**

Information from this study can be used as a basis to identify situations and groups within the local population most likely to produce rattlesnake envenomation. Medical management alone resulted in less morbidity than when combined with surgical procedures. Although antivenin use is associated with a significant incidence of reactions, these can be relieved with appropriate therapy. Coagulopathy frequently follows envenomation but is usually a benign process and systemic bleeding was not a problem clinically. Respiratory paralysis did not occur.

### **ADDENDUM:**

The above unpublished report was submitted to Wyeth Laboratories in 1982, and health care delivery in Tucson has changed since 1980. The Arizona Poison Control And Drug Information Center has become available for lay and physician consultation on a state and national level. In addition, Emergency Medicine has become a medical specialty and these specialists practice in Emergency Medical Departments at most hospitals. Both changes have improved the care of snakebite victims in Arizona.

It should be pointed out that not all rattlesnake bite victims were included in this study during 1973 - 1980. Those victims not admitted to the hospital were not included because their records were not available. These non-admitted persons would include individuals having bites without signs of envenomation, or those with mild signs who were observed several hours and discharged from the Emergency Department; and those patients who refused admission and signed out against medical advice. Their numbers are unknown but are probably another 10 - 20%.

To my knowledge, this is the only study which compared consecutive hospital admissions for snakebite in all hospitals in a community. The study, however, has not been continued since 1980.

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### **RELATED ARTICLES BY THE AUTHOR**

Hardy, Dayid L., Monette Jeter and James J. Corrigan, Jr. Envenomation by the northern blacktail rattlesnake (*Crotalus molossus molossus*): report of two cases and the *in vitro* effects of the venom on fibrinolysis and platelet aggregation. *Toxicon* 20(2) 487-493, 1982.

\_\_\_\_\_, Snakebite update: *Crotalus* envenomation in Tucson, 1973 - 1908, and comments on the new Australian method of first aid for elapid snakebites. AAZPA 1982 Annual Proceedings 1982: 430-435.

\_\_\_\_\_, Envenomation by the Mojave rattlesnake (*Crotalus scutalatus scutalatus*) in southern Arizona, U.S.A. Toxicon 21 (1) 111 - 118 1983.

\_\_\_\_\_, Donald B. Kunkel, Findlay E. Russell and Albert L. Picchioni. Management of poisonous snakebite (American Association of Poison Control Centers, Scientific Affairs Subcommittee). Vet Hum Toxicol 25(2) 135 - 137, 1983.

\_\_\_\_\_, Venomous snakebite in North America: some current views on management. Abstracts and Papers - 1985 Annual Meeting, American Association of Zoo Veterinarians, 102 - 104.

\_\_\_\_\_, Fatal rattlesnake envenomation in Arizona: 1969 - 1984. Clinical Toxicology, 24(1) 1 - 10, 1986.

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