

Envenomation effects of a snakebite by the Great Lakes Bushviper, *Atheris nitschei* Tornier 1902, from Kivu, Zaire in April 1981, with notes on its venom and other bites

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INTRODUCTION

The tropical Central African bush vipers of the genus *Atheris* are comprised of 16 small, arboreal species that extend from Guinea to Uganda, southward to the Democratic Republic of the Congo and Mozambique (MCDIARMID et al., 1999; WALLACH et al., 2014; SPAWLS et al., 2018). Eight of the species are rare and another six species have small distributions; only *A. chlorechis* of West Africa and *A. squamigera* of Central Africa have large ranges (DOBIEY & VOGEL, 2007; CHIPPAUX & JACKSON, 2019). One species from the easternmost part of the generic range, *Atheris nitschei* Tornier

(1902), commonly known as Nitschei's Bushviper, Great Lakes Bushviper, and Sedge Bushviper, inhabits mountains of the Albertine Rift of East Africa, a north-south strip in the easternmost Democratic Republic of the Congo (E. Nord-Kivu, E. Sud-Kivu and N.E. Katanga provinces), southwestern Uganda (Bushenyi, Kabale, Kabarole, Kanungu, Kasese, Kisoro, Ntungamo and Rukungiri districts), Rwanda (Eastern, Northern and Western provinces), and western Burundi (Bururi, Muramvya and Mwaro province) (BROADLEY, 1998; MALLOW et al., 2003; DOBIEY & VOGEL, 2007; O'SHEA, 2018; SPAWLS & BRANCH, 2020). It may be a common species where it lives but is not often encountered as it inhabits highlands from 1600–2800 m, is arboreal and nocturnal in behaviour, and occurs in limited regions (PITMAN, 1974).

No specific antivenom or antivenin is produced for any species or subspecies of *Atheris*, and *A. nitschei* venom is expensive, selling for \$1,852/g (SA Venom Suppliers, South Africa), \$2,100/g (Latoxan Laboratory, France), \$2,464/g (Mayflower Bioscience, USA), \$4,000/g (MToxins Venom Lab, Canada), and \$10,014/g (Lucerna-Chem, Switzerland).



Distribution map of *Atheris nitschei* (from PHELPS, 2010).

Among all species of the genus *Atheris*, only a single fatality is known and that resulted from the bite of a large (71 cm length overall) *Atheris squamigera* specimen. The victim was a 37 year old male in Central African Republic who was bitten on his right shin on 20 August 1986. He was admitted to a hospital but could not be saved. He experienced massive swelling of his right foot, calf and thigh and his blood was unable to clot after one hour's time. On day 5 he vomited blood, his blood pressure suddenly dropped to 40/20, and he went into shock from which he never recovered, dying the following day (LANOIE & BRANCH, 1991). Symptoms of



Atheris chlorechis.

Photo: Walter Getreuer

envenomation by *Atheris squamigera* include, in addition to edema, haemorrhage, and pain, the following: nausea, vomiting, diarrhea, drowsiness, and impaired breathing. Laboratory studies indicate that afibrinogenemia (lack of fibrinogen) and thrombocytopenia (low thrombocyte count) in the blood are the main results of envenomation (MEBS *et al.*, 1998).

A serious bite from *A. chlorechis* on a 26 year old male in The Netherlands was treated in a hospital setting and blood parameters were studied, showing that he suffered from acute renal failure (which normalized after three weeks) and massive blood loss (5 liters in first 6 hours). Antivenin treatment began 12 hours after the bite and the victim then recovered. Haemoglobin levels dropped from 9.4 to 4.0 mmol/l after one day, platelet counts from 128 to $19 \times 10^9/l$ after 5 days; fibrinogen normalized after 5 days and platelets normalized after two weeks. Lactate dehydrogenase (LDH) values, which indicate intravascular haemolysis, increased from 267 to 1050 after day 1 and maxed out on day 5 at 5750 (TOP *et al.*, 2006).

Records exist for a half-dozen bites by *A. nitschei*, none of which were fatal. CHIFUNDERA (1990) included *A. nitschei* bites as Category II, inflicting serious effects such as local necrosis. WHO (2017) classified *Atheris* venom as Category 2 (secondary medical importance), capable of causing morbidity, disability or death. *Atheris* venom

is known to be haemotoxic, causing severe pain, inability to clot blood, and destruction of red blood cells. The present account represents the first experienced but seventh published snakebite by *A. nitschei*. A synopsis of the experience was reported by SHOUMATOFF (1986: 213–216).

CASE DESCRIPTION

This snakebite occurred while I was on a trip while studying the snake collection of the old Belgian Congo Central African Research Institute (IRSAC – Institut de Recherche Scientifique de Afrique Central) in Lwiro (Kivu, Zaire, now D.R.C.), where Laurent deposited much of his Congolese material, and travelling to Kisangani to catch the riverboat for the 10-day, 1600 km trip down the Congo River to Kinshasa. Ten live *Atheris nitschei* were collected/purchased from the vicinity of Lwiro (elev. 1600 m) during March and April, 1981. My age was 34, my weight 69 kg, and my height 1.7 m. I was bitten while in Kisangani awaiting the arrival of the boat for Kinshasa. An exchange of three *A. nitschei* was brokered with the director of the local zoo for a beautiful adult Rhinoceros Viper (*Bitis nasicornis*) and in the process of hurriedly removing three snakes from their bag, I was accidentally bitten by an adult individual of unknown gender ca. 50 cm in length. Up to that point the snakes had been docile and freely handled.

day \ affected body parts	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39		
middle and index finger	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2			
other fingers and palm	1	1	1	1	1	1	1	1	1	1	1	1	1	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3												
back of hand	1	1	1	1	1	1	2	2	2	2	2	2	3	3	3	3	3																								
inner forearm	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	3	3	3																					
outer forearm	1	1	1	1	1	1	1	2	2	2	2	3	3																												
biceps	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	3	3																							
triceps	1	1	1	1	1	1	1	2	2	2	2	2	3	3	3	3																									
deltoid			1	1	1	1	1	2	2	2	2	2	3	3	3	3																									
neck			1	1	1	1	1	1	2	2	2	3	3																												
pectoralis+latissimus dorsi			1	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3	3	3																					
rectus abdominis					1	1	1	2	2																																
internal+external obliques					1	1	1	1	1	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3												
trapezius					2	2	2	2	2	3	3	3	3	3																											
kidneys						1	1	1	1	1	1	1																													
radial and ulnar nerves						1	1	1	1	1	1	1																													
humeral nerve	1	1	1	1	1	1	1	1	2	2	2	3	3	3																											

Table 1. Chart of intensity of swelling in affected regions over first 6 weeks (1 = strong, 2 = moderate, 3 = mild).

day \ affected body parts	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39		
middle and index finger	1	1	1	1	1	1	2	2	2	2	2	3	3	3																											
other fingers and palm																																									
back of hand	1	1	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3																								
inner forearm		1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	
outer forearm		1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3
biceps			1	1	1	1	1	1	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
triceps			1	1	1	1	1	1	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	
deltoid			1	1	1	1	1	1	2	2	2	3	3	3																											
neck				1	1	1	2	2	2	3	3	3	3	3																											
pectoralis+latissimus dorsi			1	1	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3	3																					
rectus abdominis						1	1	1	2	2	2																														
internal+external obliques							1	1	1	1	1	1	1	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3												
trapezius							2	2	2	2	2	3	3	3	3																										
kidneys					2	1	1	1	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3													
radial and ulnar nerves																																									
humeral nerve																																									

Table 2. Chart of intensity of stinging/burning sensation in affected regions over first 6 weeks (1 = excruciating, 2 = moderate, 3 = mild).

One may notice sometimes that there is not an exact correspondence between symptoms recorded in the text and the data in the tables since the tables were constructed at a later date based solely on my original notes (not my memory of events), perhaps less influenced by the effects experienced at the time.

day \ affected body parts	1	2	3	4	5	6	7	8	9	0	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3		
middle and index finger																																							
other fingers and palm																																							
back of hand																																							
inner forearm					1	1	1	1	1	2	2	2	3	3	3	3																							
outer forearm					1	1	1	1	1	2	2	2	3	3	3	3																							
biceps					1	1	1	1	1	2	2	2	3	3	3	3																							
triceps					1	1	1	1	1	2	2	2	3	3	3	3																							
deltoid					1	1	1	1	1	2	2	2	3	3	3	3																							
neck					1	1	1	2	2	2	3	3	3	3	3																								
pectoralis+latissimus dorsi		1	1	1	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3	3																			
rectus abdominis							1	1	2	2	2																												
internal+external obliques							1	1	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3	3	3	3	3												
trapezius							1	1	2	2	2	3	3	3	3																								
kidneys					2	1	1	1	1	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3											
radial and ulnar nerves							1	1	1	2	2	2	3	3	3	3																							
humeral nerve							1	1	2	2	2																												

Table 3. Chart of intensity of aching in affected regions over first 6 weeks (1 = excruciating, 2 = moderate, 3 = mild).

day \ affected body parts	1	2	3	4	5	6	7	8	9	0	1	1	1	1	1	1	1	1	2	2	2	2	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3		
middle and index finger							1	1	1	1	1	1	1	1	1	2	2	2																						
other fingers and palm					2	2	1	1	1	1	3	3	3	3	3																									
back of hand					2	2	1	1	1	1	1	3	3	3	3	3																								
inner forearm					1	1	1	1	1	1	1	2	2	2	2	2	3	3	3	3	3																			
outer forearm							1	1	1	1	1	1	2	2	3	3	3	3																						
biceps					1	1	1	1	1	1	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3													
triceps							1	1	1	1	2	2	2	2	2	2	3	3	3	3	3	3	3	3	3	3	3													
deltoid							1	1	1	1	2	2	2	3	3	3																								
neck																																								
pectoralis+latissimus dorsi										1	1	1	2	2	3	3																								
rectus abdominis							1	1	1	2	2	2																												
internal+external obliques							1	1	1	1	1	1	2	2																										
trapezius							2	2	2	2	2	3	3	3	3																									
kidneys					2	2	1	1	1	1	3	3	3																											
radial and ulnar nerves																																								
humeral nerve																																								

Table 4. Chart of intensity of hemorrhaging in affected regions over first 6 weeks (1 = excruciating, 2 = moderate, 3 = mild).

RESULTS

On 18 April 1981 at 16:00 hours (one hour before the closing of the zoo and expected exchange of specimens), while holding a bag

with 10 adult *Atheris nitschei* in my right hand, I reached in with my left hand to extract three specimens and was bitten by a single individual on the index and middle fingers. Both fangs penetrated the skin but it

appeared that venom was only injected through one fang. The snake's left fang hit my index finger 1/3 of the way between the second knuckle and the finger's base while the right fang hit my middle finger midway between the knuckle and base. Automatically withdrawing my hand caused my fingers to spread apart, trapping the snake's fangs so that it could not release its hold on me. As I watched in mild shock for perhaps two seconds I saw the skin around the right fang swell up in a small nodule ca. 5–6 mm in diameter (the size of a green pea). Realizing that this was venom being injected subcutaneously, I quickly grabbed the snake and wrenched it free from my hand. An immediate stinging sensation was felt in both fingers, even though the left puncture site did not swell up. The following notes record my symptoms and observations of the bite over the following year. During the first three days the pain was so intense that I was unable to

satisfactorily record my experiences and my remarks are based only on unintelligibly scribbled notes and my fragmented memory of events during those first days.

I was unable to make measurements for the first few days but comparison of measurements of the circumference (in cm) of my upper arm, forearm, hand and middle finger of the left side on day 5 after the bite (38.5, 34.5, 28.0 and 10.5) and the right side (26.0, 24.5, 23.5 and 7.0) shows that the limb increased ca. 1/3 in size (respectively, 32%, 29%, 16% and 33%). By day 9 the measurements were, respectively, 35.0, 31.0, 26.0 and 9.5 cm, showing an increase of only ca. 1/4 of normal size (26%, 23%, 12%, 26%). There was no discolouration for the first three days and the puncture sites never discoloured. General effects included swelling extending along left half of upper body from neck to waist (and also calf and knee), fever, chills and diarrhea; tachycardia;



Atheris nitschei.

Photo: Walter Getreuer

vertigo, weakness, dizziness and faintness; numbness; orange and red urine along with painful kidneys; stomach muscles turning to jelly and a hard strap of tissue developing along inner arm; recurring pain along bones (nerves ?) of inner surface of forearm and upper arm. The only frightening aspect of the entire ordeal was the development of severe abdominal edema that lasted for four days, which scared me into thinking that the condition might be permanent. When I walked I had to hold tightly to my belly as I feared it might shake loose or end up separating my abdominal muscles from their attachments. I feared that my stomach might remain in its viscous condition, resulting in permanent damage. Likely it was a form of edema, fluid retention in body tissue, here perhaps in the skin on part of the abdomen?

Day 1 (18 April): (5 min.) both fingers swollen to bases; (15 min.) stinging, tingling, and radiation-like burning sensation spreading throughout hand; (25 min.) back of hand starting to swell, pain commencing along forearm; (35 min.) swelling beginning on palm of hand; (1 hr.) distal half of back of hand swollen to twice normal size, pain starting in armpit; (1 hr. 20 min.) $\frac{3}{4}$ of palm swollen; (1 hr. 40 min.) hand and wrist beginning to throb, terrible thirst and hunger developing; (4 hr.) incredibly intense burning pain in hand, vertigo and nausea commencing, when lying prone in bed I am all right but when sitting up or standing I experience tachycardia, weakness and faintness; (12 hr.) entire palm swollen with forearm starting to swell, no discolouration present.

Day 2 (19 April): (18 hr.) half of forearm swollen, afflicted area throbbing painfully, hand appears twice normal size with middle finger particularly expanded, all fingers swollen in slightly flexed position and absolutely immobile, only immersion in cold water provides temporary relief from burning sensation; (23 hr.) pain excruciating, $\frac{3}{4}$ of forearm swollen, lymph nodes in armpit very painful, able to rotate hand at wrist about 20°; (25 hr.) swelling reaches elbow, pain terrible, no haemorrhage visible yet, extreme effort required to walk more than a few meters, when attempting to get a drink of water or go to the toilet I could only take a couple steps before having to kneel or lie down and

recuperate before trying another few steps, incredibly weak, faint and dizzy.

Day 3 (20 April): (30–38 hr.) arm pain unrelenting during night, preventing sleep, whenever I entered a semiconscious state preparing to doze off the pain would bring me back quite awake again, after fatigue made me drowsy once again I would awaken with pain before falling asleep, a cycle that continued throughout the night; (39 hr.) swelling reaching shoulder and starting down the muscle *latissimus dorsi*, intense pain all along arm and hand, being sensitive to slightest pressure, lymph nodes in armpit swollen, forearm turning reddish-purple; (44 hr.) urine bright orange, vertigo and tachycardia continue whenever I stand up, prickling 'pins and needles' sensation all over affected area; (46 hr.) entire *latissimus dorsi* swollen and *pectoralis major* beginning to swell up, wrist entirely immobile; (50 hr.) swelling commencing up base of neck, $\frac{1}{2}$ of the muscle *pectoralis major* swollen, lymph node pain in armpit diminishing; (51 hr.) at urging of hotel staff, enter Kisangani hospital (19:00 hours) and am given two aspirin and a valium, prescription written for (1) procaine penicillin, (2) streptomycin, (3) Novalgine, and (4) Tanderil but unable to fill as pharmacies in town closed, difficulty in breathing over next 3–4 hours before finally falling asleep (felt as if there was a constriction around my chest and I couldn't get enough oxygen even though I was breathing deeply).

Day 4 (21 April): (62 hr.) slept fitfully for entire night (first real rest since being bitten), waking with a sore lower back from soft, saggy hospital bed, extremely difficult to find a comfortable position, arm swollen in immobile position with a 90° angle at the elbow, only possible positions that do not induce further pain are lying on my back or inclined slightly on my right side, the reddish-purple discolouration begins on inside of upper arm; (67 hr.) perfusion of saline solution (0.4 liter) with 1 g of hydrocortisone administered intravenously, no noticeable effect on swelling or pain, medications finally purchased, only penicillin from original prescription available in town, three others substituted: (1) injectable procaine penicillin [2 vials], (2) ampicillin capsules, (3) Glifanan tablets for acute, traumatic and chronic pain,

and (4) Vellopan [Indomethacin] capsules, an anti-inflammatory, began taking maximum doses of the three oral medications, an unknown pain-killing injection given by hospital but, like the other medications, without noticeable effect; (72 hr.) necessary to leave hospital in afternoon to catch boat to Kinshasa, nausea and vertigo still present, can walk about 5 m before collapsing from weakness, dizziness and nausea, neck muscles swollen and aching on both sides up to base of skull, quite painful to turn neck in either direction, swelling has spread over all of *pectoralis major* muscle and $\frac{3}{4}$ of *latissimus dorsi* on left side, elevation of torso causes immediate tachycardia and my arm to sting, burn and ache simultaneously, tingling sensation persists and pain remains at a high level.

Day 5 (22 April): nausea disappears but vertigo and tachycardia persist when upright or walking, swelling exhibits most extreme development with extension to abdominal region, abdominal muscles (or subcutaneous tissue) have consistency of Jello and actually quiver when I move, causing pain in my mid-body region, kidneys become painful and urine turns dark orange, purple and red discolouration spreading over forearm and faint discolouration appears on fingers and palm of hand, blistering begins on two bitten fingers, which are now slightly movable, I begin taking daily injections of penicillin (3 million units) and Novamine (pain-killer) for a period of one week (I was given a supply of penicillin hypodermics to inject once a day).

Day 6 (23 April): woke up at 03:00 hours with intense pain adjacent to the bones of my forearm, palm light purple all over, upper abdomen turning purple, puncture sites appear normal, lacking discolouration, lymph nodes mildly painful still, kidney pain increasing and sitting, turning my body or even moving puts pressure on my kidneys, resulting in terrible pain, the only comfortable position is lying supine, flexibility increasing a bit as I now am able to just touch fingertips to head for first time but cannot yet bend the elbow. For the next week the worst pain is that which cyclically recurs deep in my arm as a narrow rod of pain along the radius and ulna of my forearm. Is this a nerve?

Day 7 (24 April): woke up at 04:00 hours with unbearable pain along the humerus (upper arm) from my shoulder to the elbow, which

lasted several hours before subsiding, swelling has not reduced at all, entire arm is discoloured now as outer arm is turning purple and red, swollen area of the hand and arm now very hard and tight feeling, blistering beginning on the back of my hand, the backs of all five fingers have turned purple at their bases, swelling has terminated at level of waist, lower abdomen turns purple, mid-body region still extremely painful to touch, very limited movement of fingers and joints now possible and I can press all fingers together now, arm begins hurting along the bones (radius/ulna) from elbow to wrist at 19:00 hours, forearm and wrist again appear to swell to the bursting point of my skin, any type of stress or strain causes my arm to sting and burn, feeling like a severe sunburn, still no discolouration around the puncture sites, vertigo finally disappears. Boat stopped at Mbandaka and I was able to buy some Cal-C-Vita (2350 mg vitamin C, 300 IU vitamin D, 15 mg vitamin B₆, and 250 mg calcium) tablets and I began taking three/day.

Day 8 (25 April): woke up at 05:00 hours with recurring pain along my arm bones, pain absolutely excruciating in both upper and lower arms, the inner half of arm very tight like a metal cable but outer portion merely swollen, abdominal viscosity disappears today (thankfully!) and finally it doesn't hurt to walk now, swelling of arm finally starting to subside, an effect of the vitamin C therapy (which was the only medication that elicited results), still necessary to lie down flat or my arm aches badly, direct sunlight hurts my arm (as if sunburned), pain pills continue to be ineffective but I am able to sleep more than before, hand still swollen and hard, not puffy and soft, with back of hand continuing to blister, fingers start itching, flexibility increasing as I can now touch the back of my head with fingertips and thumb can touch forefinger, blood pressure 120/60.

Day 9 (26 April): woke up at 03:30 hours with same intense arm pain along with a fever and diarrhea, which was followed by alternating hot and cold spells (a unique development), vertigo returns again, itching spreads to back of hand, swelling rapidly subsiding since yesterday but inner arm still resembles a tight steel band, arm pain intense, still hot and stinging with persistent prickly pins and needle sensation, hurting mainly with applied pressure, able to lean on elbow for first time



Photograph of a living *Atheris nitschei*.

Photo: Reptiles4all, The Netherlands

without distress, swelling has reduced a little on palm and back of hand but cannot close fingers yet to make a fist, inner side of left knee haemorrhages and small purple spots appear, calf muscle (*gastrocnemius*) sore and area behind knee very tender, neck muscles on both sides continue to ache with movement. At 18:00 hours urine changes from dark orange to pinkish-orange, kidneys still painful, skin on back of hand no longer itching but feels very tight now, similar to the first day when it swelled up, purple discolouration of torso commences from left pectoral and lateral edge of *rectus abdominis* across the rib cage and obliques to the rear of the body adjacent to *erector spinae* muscles, *rectus abdominis* muscles never swelled up, only the external and internal obliques experienced the subcutaneous edema.

Day 10 (27 April): general swelling continues to reduce but pain persists along bones of inner arm, lymph nodes still swollen and uncomfortable.

Day 11 (28 April): discolouration on arm starting to fade away, began wearing arm in a sling today, which helps relieve pain when upright, pain continues internally, in the kidneys, and along the inner arm's tight band, no discolouration of fang sites, back of hand with single purple spot, waist still pink, last penicillin injection administered.

Day 12 (29 April): woke up again at 03:00 hours with excruciating pain in elbow joint and along outer forearm, at 11:00 hours the typically recurring inner arm pain commences from my shoulder to wrist, new symptoms develop at 18:00 hours with swelling starting

again on inner wrist and accompanied by distinct numbness along outer side of forearm, kidney pain improved but still sensitive, all discolouration of palm and back of hand has disappeared except for a centrally placed purple "V", with apex proximally, and a purple spot on the ring finger, no swelling or discolouration has affected the puncture sites, still cannot close hand entirely or extend elbow although I can flex my elbow completely closed, arm nearly all purple but discolouration on chest greatly reduced and only faintly visible.

Day 13 (30 April): hand and forearm remain swollen, soft and puffy, painful to touch, numbness spreading over entire hand, forearm and shoulder but upper arm not affected, swelling still diminishing, however an unbearable itching sensation is beginning all over, which, against my better judgment, is causing me to constantly scratch it.

Day 14 (1 May): marked reduction in swelling and discolouration of inner side of upper arm (where first discolouration appeared) and forearm, pain still constant and intense but I am able to move hand and arm more without additional suffering, outer two fingers reduced to normal size, middle finger still immensely swollen and immobile, envenomation sites nearly unaffected with peeling of skin around puncture site on index finger and a tiny depression present at site where majority of venom was injected, haemorrhage of chest, lateral rib area, under left arm and outer waist region nearly vanished, able to bend arm $\frac{3}{4}$ of the way open at 18:00 hours, entire forearm and hand numb with a rubbery feeling, insatiable itching of skin on both upper and lower arm.

Day 15 (2 May): arm muscles still aching and numb, with intense pain continuing along bones, inner surface of arm still consists of a rock hard band or strap, upper arm still discoloured, impossible to straighten arm completely, all fingers except middle one back to normal size but they are painful when flexed, kidneys only slightly painful, still have difficulty sleeping restfully.

Day 16 (3 May): swelling of arm still decreasing, left arm approaching its normal size, pain persists, making it hard to sleep comfortably, hand still numb but fingers okay, purple colouration remains only on upper arm (both triceps and biceps) and inner surface of forearm, middle finger still greatly swollen,

still cannot close fist or straighten elbow, lymph nodes still sore and swollen.

Day 17 (4 May): trouble sleeping continues as pain keeps waking me up, greatest pain along strap-like band along biceps and forearm, back of hand still swollen, discolouration forms purple bands along entire outer arm plus inner forearm, where pain continues, forearm and hand remain numb, kidney pain terminates.

Day 18 (5 May): pain in arm continues as before, cannot straighten arm yet, forearm discolouration nearly gone, tendons on back of hand now visible as swelling continues to diminish, only middle finger remains enlarged, tight band still present on inner surface and a large transverse cord raised across mid-biceps region.

Day 19 (6 May): pain continues and swelling still reducing, hand and forearm remain numb but skin extremely itchy, hot stinging pins and needles sensation disappears when straining muscles.

Day 20 (7 May): still cannot completely straighten arm, arm hot and numbness continues, lasts still sore, even after the oblique pain disappeared, and still very painful to turn or twist body, can bend fingertips to within 3 cm of palm, veins in bend of elbow visible today, tendons of hand clearly visible.

Day 21 (8 May): pain continues with arm itching badly, upper arm pain gone, only forearm and inner elbow remaining painful, a small purple patch remains on upper and lower arm, knuckles now visible, able to make a fist today (touching fingers to palm) and can nearly straighten arm.

Day 22 (9 May): shoulder, forearm and hand still numb and tingling, forearm discolouration has disappeared, can almost straighten elbow to 180°, tight band persists on inner arm, elbow and biceps, arm hot again.

Day 23 (10 May): middle finger still swollen, skin peeling on palm, dark brown transverse scar remains across lower biceps, covering half of upper arm diameter, upper arm discolouration gone.

Day 24 (11 May): very little pain left, arm nearly straight now, only shoulder and forearm remain numb, arm band still tight, palm of hand tender and slightly swollen, able to close hand comfortably now but hand is weak for holding things, middle finger remains large, arm still hot.

Day 25 (12 May): kidneys and obliques still slightly tender, arm hurting again, skin of palm still peeling, creases in elbow fold are dark brown and scar-like as is biceps scar.

Day 26 (13 May): able to completely straighten arm now but it is still a little swollen and painful, grip much stronger today, kidney and oblique pain gone, tight band remains along inner arm, upper arm now itchy and arm very hot to touch.

Day 27 (14 May): dark transverse marks remain on biceps where skin creases were, larger veins starting to be visible, middle finger still swollen, arm pain only felt when extending arm 180°, deltoid still sore but not numb anymore, forearm still numb, sensation returning to back of hand which is still slightly swollen.

Day 28 (15 May): inner forearm itching badly, tight band remains, deltoid and forearm still numb, middle finger still swollen.

Day 29 (16 May): middle finger and knuckle still swollen, numbness in shoulder nearly gone but still persists in forearm, palm tender.

Day 30 (17 May): pain only occurs when stretching or flexing arm or with direct pressure, finger still swollen, deltoid, arm and back of hand still slightly numb, dark lines remain across inner elbow and biceps, smaller veins in elbow now visible.

Day 31 (18 May): numbness, pain, and swelling remain the same.

Day 32 (19 May): no change in condition, palm skin still peeling.

Day 33 (20 May): no change in condition.

Day 34 (21 May): forearm itchy today, numbness still present with a little pain.

Day 35 (22 May): dark discolouration remains on creases in arm.

Day 36 (23 May): no change in condition: itchy, swollen, numb, and a little pain.

Day 37 (24 May): arm still hot, it hurts to completely stretch it out straight.

Day 38 (25 May): forearm continues to itch and feel numb.

Day 39 (26 May): hand painful to squeeze or stretch, arm itchy, swelling of middle finger now reduced by 50%, dark transverse scar remains, arm still hot and a little stiff.

Day 40 (27 May): middle finger smaller but still swollen, all tendons on back of hand visible with extension of fingers.

Day 41 (28 May): dark transverse scars (two creases in elbow and one across biceps 5 cm from joint) remain, deltoid and forearm still a

little numb, hand painful to extend fingers or close fist.

Day 42 (29 May): colouration of entire arm darker than right, appearing like a suntan, especially around inner elbow and inner arm areas, biceps veins visible today, bones of forearm painful to press.

Day 43 (30 May): middle finger still swollen, arm dark, can straighten arm now without pain but painful to stretch fingers.

Day 44 (31 May): forearm and hand still sensitive to strong pressure, dark lines remain, painful to flex hand backwards.

Day 60 (16 June): entire arm a shade darker than right, middle finger still slightly swollen, dark creases remain on arm.

Day 130 (25 Aug.): middle finger 8 cm circumference, right finger 7 cm (12% swollen).

Day 200 (3 Nov.): left arm still slightly darker than right one but dark creases have disappeared, the middle finger still slightly enlarged.

Day 365 (17 April): tiny scar remains from index finger puncture but no trace of mark on middle finger, which is still slightly swollen (7.5 cm vs. 7 cm), left arm only slightly darker than right arm.

DISCUSSION

I have been able to track down references to a half-dozen other *Atheris nitschei* bites, none of which were fatal. Case #1 involved Micah Stancil, who was bitten by both fangs on the left hand and experienced tremendous pain and swelling past the elbow. He lost consciousness for four hours at the hospital; upon waking the swelling was up to his shoulder. The venom inhibited his blood to clot so he had to stay in the hospital for two weeks, by which time the swelling had mostly disappeared. His hand remained stiff and blistered but eventually the only lasting effect was a stiff joint on the bitten thumb (Stancil, 2000).

Case #2 concerns a private herpetoculturist that was bitten in 1996 and experienced a serious medical emergency (SWAZI, 2007).

Case #3 involved Justin Moss, a pet shop owner in Pretoria, who was bitten on his right index finger on 26 September 2007 and experienced excruciating pain as if boiling hot water or acid was being injected, followed by swelling of his arm. He was taken to a hospital

within an hour and treated there (without antivenin) but during the first 24 hours he had a dozen blackouts with pain bringing him back to consciousness each time. After 12 hours Moss experienced swelling of his wrist and a burning sensation with excruciating pain in his forearm as it began to swell; he was discharged after two days, at which time his forearm, upper arm

and shoulder were three times the natural size; after 2.5 days he became nauseous and vomited, blue/purple discolouration began on his inner arm, and he experienced unbearable pain at any pressure on the arm; during day 4 the swelling had spread down to his waist but was decreasing on his arm and he could not stand or walk for long, the pain still extreme; on day 5 he experienced cold sweats, nausea, and vomiting with the pain moving down his hip and into his kidneys; by day 6 his kidneys were very painful, and swelling reached the lymph nodes in his groin; day 7 saw improvement in both swelling and pain but unbearable itching began on finger; by day 8 the worst of the symptoms had disappeared (MOSS, 2007).

Case #4 involved a 30 year old male bitten on his left hand. His left upper arm was edematous (swollen) with ecchymoses (discolouration of skin from haemorrhage) in the armpit and he was bleeding from his oral mucosa. Laboratory studies revealed significant hematologic aberrations of haemorrhage and anticoagulant ability, including anemia, thrombocytopenia, coagulopathy, and hypofibrinogenemia (HATTEN et al., 2013).

Case #5 involved Eberhard Fischer in Rwanda but specific details about the bite are lacking (H. HINKEL, pers. comm., in SPAWLS et al., 2018).

Case #6 involved another person in Rwanda but details are unknown (H. Hinkel, pers. comm., in SPAWLS et al., 2018).

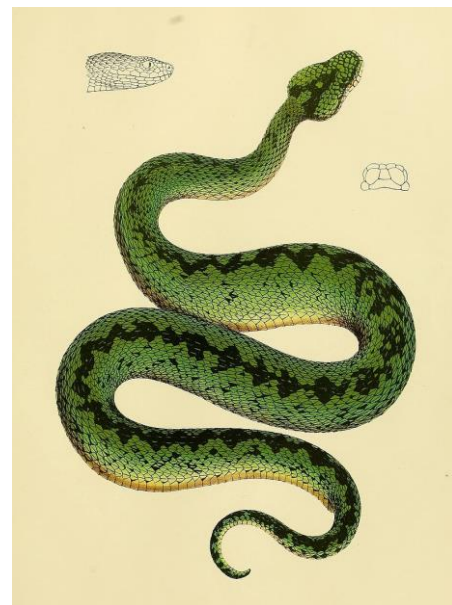


Illustration of *Atheris nitschei* (BOULENGER, 1906).

Various studies have shown that the venom of *A. nitschei* has some unique components, which consist primarily of phospholipases (edema inducers), disintegrins (platelet inhibitors), serine proteases (enzymes that break down proteins), and metalloproteases (enzymes that work with calcium or zinc atoms to break down collagen tissue) (WANG et al., 2013, 2018). It possesses a novel phospholipase A₂ protein (WANG et al., 2016), it has a novel disintegrin precursor (WANG et al., 2013), and it contains a new class of histidine and glycine residue peptides (FAVREAU et al., 2007).

In brief, even though *Atheris* species are generally small in size and do not appear dangerous, their bites have mild to serious effects that always include unbearable pain (as from fire-like or radiation-like burning, severe sunburn, boiling water or acid), swelling of the bitten limb or more extensive region (to several times normal size), and a purple/blue/black discolouration of the skin but also incorporates some nausea, dizziness, fatigue, insomnia, blackouts, internal bleeding, and itchiness.

Anyone hunting, collecting, or keeping *Atheris* species should take precaution when catching, handling or moving them as no antivenom was nor is available.

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SUMMARY

I experienced six previous bites by venomous snakes in Zaire from 1979–1980 (three by *Causus maculatus* and one each by *Atractaspis irregularis*, *Naja christyi* and *Naja melanoleuca*), two of which were dry, resulting in effects lasting from two hours to two weeks (WALLACH, 1980a-b). In contrast, the bite by *Atheris nitschei* in 1981 produced severe consequences lasting up to a year afterwards.

SAMENVATTING

Gedurende mijn verblijf in Zaïre van 1979-1980 werd ik zesmaal eerder gebeten door gifslangen (driemaal door *Causus maculatus* en eenmaal elk door *Atractaspis irregularis* en *Naja christyi* en *Naja melanoleuca*), waarvan er twee geen gif inbrachten en had ik daarvan slechts twee uur tot hooguit twee weken last (WALLACH, 1980a-b). Daarentegen veroorzaakte de beet van *Atheris nitschei* in 1981 ernstige gevolgen die tot een jaar later nog merkbaar waren.

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