Austere Snake Envenomation Management

*Bringing Snakebite Treatment to the Point of Injury*

Jordan Benjamin, Executive Director Asclepius Snakebite Foundation

Photo by Thomas Nicolon for National Geographic

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Introduction & Disclosures

- **Jordan Benjamin**: Herpetologist and clinician with over a decade of experience treating snakebites in rural Africa
- **Nick Brandehoff**: Emergency medicine physician and medical toxicologist / herpetologist
- **Co-founders of the Asclepius Snakebite Foundation**

Leading experts in austere envenomation management and lead authors of the upcoming CPG on Austere Snake Envenomation Management

No potential conflicts of interest to disclose.
Time to shift the thinking on antivenoms

Antivenom is to snakebite what whole blood and a surgeon are to trauma!

New field stable antivenoms and a symptom-driven syndromic approach to snakebite management make field treatment the new standard of care (and you don’t need to identify the snake)
Do not delay antivenom until the hospital!

Time is tissue and the clock starts at the moment that an envenomation occurs

- Critical snakebite patients may have venom-mediated issues that only resolve with antivenom
  - Stop & fix direct venom-mediated effects (hypotension, CV collapse, AMS, uncontrolled internal bleeding, etc)

- NEUROTOXINS – neutralize before they have bound to receptors or destroyed the nerve terminal

- CYTOTOXINS - neutralize before irreversible tissue damage has occurred

NOTE: some older antivenoms had an incidence of anaphylaxis up to 75%, newer next gen antivenoms recommended for field use in the CPGs have an incidence of 1% or less. With these products, the high risk posed by untreated venom in the body far outweighs the low risk of a manageable allergic reaction to antivenom. Field treatment is only recommended for specific antivenoms designed for austere environments; those that do not meet these standards are for role 2 / 3 only.
Forget about the snakes! Too many to learn and doesn’t change your management.
Snakebites do not always result in envenomations!

Dry bites and mimics make fang marks and snake ID useless for determining envenomation

- Roughly 25% of bites from venomous snakes are “dry” with no venom injected
- Many dangerous species have harmless mimics that look alike
Focus on the syndromes! Time for a crash course...

The key to simple, effective, and accurate snakebite management is to use the skills you already have as a medical provider. Identify the key signs and symptoms of the three major syndromes and work from there.
Every snake that can kill or injure you worldwide will ultimately present with one or more of the three major syndromes of snake envenomations. Remember the triad of symptoms for each of these as we move forward...

**NEURO**
- Descending Paralysis
- Dyspnea / AMS

**HEMO**
- Local Bleeding
- Systemic Bleeding

**CYTO**
- Progressive Edema
- Tissue Destruction

**BILATERAL PTOSIS**

**COAGULOPATHY (VICC)**
Early red flags = ptosis and double vision


Photo by Dr. C Baldé
Mambas = cholinergic syndrome “wet paralysis” looks like organophosphate (SLUDGEM)

Black mamba envenomation

Progression in first 3 hours after bite

Photo by Dr. C Balde. Black Mamba; @H0

Photo by Dr. C Balde. Black Mamba; @H3
Cobras = curare-like “dry paralysis”

All neurotoxic bites converge at the forehead and move down with ptosis and descending paralysis regardless of local S/Sx or SLUDGEM toxidrome.

Forest cobra bite

Photo by Dr. Jean-Philippe Chippaux

Figure 3 Neurotoxic syndrome due to *Naja melanoleuca* bite (note pathognomonic ptosis) Photo by E. Stahel.

Hemotoxic – Local becomes systemic

If a tiny puncture wound is still leaking blood 30 minutes later, you have a venom mediated issue

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Great outcomes with antivenom

INITIAL PRESENTATION (PRIOR TO ANTIVENOM)
ONE DAY AFTER ANTIVENOM TREATMENT
FIVE DAYS AFTER ANTIVENOM TREATMENT

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Example below: early presentation of puff adder bite

Pro tip – sharpie tips self-sterilize between patients
Late presentations with delayed treatment
How do you actually do this in remote settings?
First of all, do not make it worse!

NO TOURNIQUETS FOR SNAKEBITE

If a tourniquet was placed before the patient arrived in your care in place, leave it in place until antivenom is available and then release sequentially over time to prevent venom bolus (loosen $\rightarrow$ tighten $\rightarrow$ vitals/observation $\rightarrow$ wait 5 mins $\rightarrow$ repeat).

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ABC-A for unstable snakebites

- Airway
- Breathing
- Circulation
- Antivenom

...keep something in the bag of tricks for each one of these
**10,000 foot view algorithm:**
New CPGs for austere snake envenomation management are designed to enable every paramedic-level provider and higher to safely and effectively diagnose and treat snakebites in the field with antivenoms and targeted supportive measures.
Focus on your patient, ignore the snake: **Assessment --> Signs and Symptoms**

**Focused initial assessment: look for the triad of S/Sx for each of the three major syndromes**

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**Syndromic Approach to Snakebite Treatment: AFRICOM / CENTCOM**

<table>
<thead>
<tr>
<th>Initial Assessment</th>
<th>Neurotoxic Syndrome</th>
<th>Coagulopathy (DIC) and/or Bleeding</th>
<th>Pain, Edema, Soft Tissue Damage</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABC + IV/IO + WBCT + Vitals</td>
<td>Descending symmetrical flaccid paralysis: diplopia, bilateral ptosis, dyspnea, dysphagia, progressive weakness, decreased LOC. Mamba bites look like nerve gas (SLUDGEM)</td>
<td>Typical progression from coagulopathy → abnormal local bleeding → systemic bleeding. Bleeding from gingival sulci often first sign of systemic hemorrhage, hematemesis indicates severe envenomation.</td>
<td>Limited or extensive blistering, necrosis, and discoloration common. Pain is often severe. Cardiotoxicity possible but rare. Patients with pain, edema, bruising, blistering, necrosis, etc should all receive treatment</td>
</tr>
<tr>
<td>History &amp; Physical</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sharpie Edema &amp; Pain</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Single Breath Count Test</td>
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</table>

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**Asymptomatic patients**

Should be held for a full 24 hours from initial assessment (H0) and reevaluated at H2, H4, H6, H12, and H24

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**INITIAL ASSESSMENT**

ABC + IV/IO + WBCT + Vitals

Sharpie Edema & Pain

Single Breath Count Test

History & Physical

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**FASCIOTOMY CONTRAINDICATED.**

Compartment syndrome rare even when suspected. Any circulation, sensation, movement indicates limb perfusion.

Blisters are sterile while intact; drain only when necessary and leave roof of blister in place as a natural barrier to infection.

Assess for anemia; whole blood transfusions appropriate if criteria met but should ideally be initiated > 1 hour after antivenom therapy unless unstable patient.

Maintain high index of suspicion for internal bleeding (esp. intracranial or intra-abdominal).

Monitor single breath count test (SBCT), RR, EtCO2, SpO2 and aggressively manage airway.

Consider neostigmine trial (may temporarily reverse paralysis) to delay intubation.

Consider atropine to dry up hypersecretions and protect airway.

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Focus on your patient, ignore the snake: **Signs and Symptoms → Syndrome**

*If you have a mixed syndrome, triage up to the worst one and manage that (you will fix everything else along with it)*

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**Neurotoxic Syndrome**
- Descending symmetrical flaccid paralysis: diplopia, bilateral ptosis, dyspnea, dysphagia, progressive weakness, decreased LOC
- Mamba bites look like nerve gas (SLUDGEM)

**Coagulopathy (DIC) and/or Bleeding**
- Typical progression from coagulopathy → abnormal local bleeding → systemic bleeding
- Bleeding from gingival sulci often first sign of systemic hemorrhage, hematemesis indicates severe envenomation

**Pain, Edema, Soft Tissue Damage**
- Limited or extensive blistering, necrosis, and discoloration common
- Pain is often severe. Cardiotoxicity possible but rare
- Patients with pain, edema, bruising, blistering, necrosis, etc should all receive treatment

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**BILATERAL PTOSIS**

**NEUROTOXIC**
- DESCENDING PARALYSIS
- DYSPNEA / DECREASED LOC

**COAGULOPATHY (VICC)**
- LOCAL BLEEDING
- SYSTEMIC BLEEDING

**HEMOTOXIC**
- PROGRESSIVE EDEMA
- TISSUE DESTRUCTION

**CYTOTOXIC**
- S/Sx CYTOTOXIC + BLEEDING OR COAGULOPATHY

**SEVERE PAIN**

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Antivenom dose is severity based, not weight based! No max dosage; repeat until resolution...

### Simplified diagnosis and severity-based treatment guidelines using POLYSERP antivenoms

<table>
<thead>
<tr>
<th></th>
<th>Neurotoxic Syndrome</th>
<th>Hemotoxic Syndrome</th>
<th>Cytotoxic Syndrome</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mild - Moderate</strong></td>
<td>Local or systemic S/Sx of neurotoxic syndrome without respiratory compromise or difficulty speaking</td>
<td>Coagulopathy ± local or systemic bleeding but no hematemesis or hematochezia and patient is stable</td>
<td>Severe pain, progressive edema, tissue destruction but patient is stable</td>
</tr>
<tr>
<td><strong>Initial Dose</strong></td>
<td>4 vials POLYSERP IV/IO push</td>
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</tr>
<tr>
<td><strong>Severe</strong></td>
<td>Difficulty speaking; altered mental status; respiratory muscle weakness causing difficulty breathing; unstable patient</td>
<td>GI bleed (hematemesis or hematochezia); altered mental status; unstable patient</td>
<td>Symptomatic bite to head, neck, or torso; altered mental status; unstable patient</td>
</tr>
<tr>
<td><strong>Initial Dose</strong></td>
<td>6 vials POLYSERP IV/IO push</td>
<td>6 vials POLYSERP IV/IO push</td>
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</tr>
<tr>
<td><strong>Criteria for</strong></td>
<td>Give additional 2 vials POLYSERP for: persistence or worsening of systemic neurotoxic S/Sx. Continue to re-administer 2 vial boluses as needed at hours 2, 4, 6, 12, and 24 until indications of improvement begin to appear (‡SBCT, †LOC, †strength, speech returns, etc.)</td>
<td>Give additional 2 vials POLYSERP for: persistence, resumption, or new onset of any active external or internal bleeding OR S/Sx of active venom confirmed by secondary recurrence of abnormal WBCT OR persistence of coagulopathy (by WBCT or other lab tests) at H24</td>
<td>Give additional 2 vials POLYSERP for: edema increase by ≥ 1 grade OR significant increase in pain (severity and/or anatomical distance from bite)</td>
</tr>
<tr>
<td><strong>doses at hour</strong></td>
<td>2, 4, 6, 12, 24 (as needed)</td>
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NOTE: the table above covers dosing for the two next gen antivenoms recommended as first line (POLYSERP PAN-AFRICA / POLYSERP MENA); these are field stable, freeze dried, broad spectrum and safe enough to give by IV/IO push (< 1% incidence of significant allergic reactions) in austere settings. These first line field options enable treatment any unknown snake envenomation causing cytotoxic, hemotoxic, or neurotoxic syndromes in AFRICOM / CENTCOM using the same severity-based regimen. There is no need to identify the snake species responsible for the bite!
Clean glass tube, permanent marker, and single breath count test (SBCT) help titrate antivenom dose
Final wisdom from the late herpetologist Sanda Ashe

“Antivenom is like the Texan’s gun – he doesn’t need it often, but when he does he needs it real bad”

Don’t be afraid to give it in the field when it is needed!

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Visit us at www.snakebitefoundation.org!

Questions? Send an email to jordan@snakebitefoundation.org

I am always happy to help!

(Also check out our Prolonged Field Care podcast on snakebite treatment!)

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