Snake Bites: ED guide to envenomation **Twitter/Instagram:** @emboardbombs

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Introduction

Snakebites remain a common source of morbidity in warmer climates. In North America, most venomous snakebites are due to species from the *Viperidae* family, including rattlesnakes, copperheads, and cottonmouths[1]. *Elapidae* family members, like coral snakes, are less common but pose a different type of clinical challenge due to their neurotoxic venom[2]. So, without further ado, let's dive into the slithery world of snake envenomation!

Clinical Presentation

Patients bitten by pit vipers (photo top right) often present with immediate local symptoms such as pain, swelling, and ecchymosis at the site of the bite[5]. Systemic symptoms rarely develop and include hypotension, tachycardia, bleeding, and hemolysis[6]. Coagulopathy is a hallmark of pit viper envenomation, with laboratory studies revealing an elevated PT/INR, decreased fibrinogen, and thrombocytopenia[7].

On the other hand, coral snake bites (photo lower right) are notorious for their initially minimal local findings[8]. However, systemic neurotoxicity can lurk insidiously and develop over several hours, manifesting as ptosis, diplopia, dysarthria, muscle weakness, and ultimately respiratory failure[2].

Interestingly, not all snake bites lead to envenomation; in fact, "dry bites" occur in up to 25% of cases[3]. In such cases, clinical manifestations vary widely depending on the species, but prompt recognition and monitoring are critical to preventing serious complications[4].

Diagnosis

As you might imagine, the diagnosis of snake envenomation relies heavily on a detailed history and physical examination. Your physical exam should focus on local tissue effects, neurologic status, and cardiovascular stability[10]. Pertinent labs include a CBC, coags, CMP, creatine kinase, and type & screen for cases of significant envenomation, looking for signs of infection, coagulopathy, and readying yourself for potential blood transfusions your patient may need[11].

Why labs? Along with placing an objective value on the severity of the potential envenomation, venom-induced consumption coagulopathy (VICC) is the hallmark systemic complication from pit viper envenomation. Essentially, this venom contains procoagulant toxins that rapidly deplete fibrinogen and clotting factors. The result is a "pseudo-DIC" picture with elevated PT/INR, low fibrinogen, and thrombocytopenia - except without the microangiopathic hemolytic anemia you'd expect in true DIC. Clinically, patients present with spontaneous bleeding, oozing from IV sites, and/or mucosal hemorrhage. It's worth noting that VICC doesn't typically cause end-organ damage, but it absolutely warrants prompt antivenom administration to neutralize circulating venom and halt progression of this dangerous coagulopathy[16]. So, to answer our early question, serial coagulation labs are *crucial* to guide treatment and confirm resolution in cases of VICC.

If asymptomatic or presenting without any systemic symptoms, one important point is a description of the snake. Though it can be tough to tell in the moment, pit vipers are easily distinguishable from coral snakes. The former is known for its triangular head, elliptical pupils, and nostril pits anteroinferior to the eyes. Coral snakes on the other hand are known for their alternating red-yellow-black pattern. There are a few snakes that mimic this pattern but are in fact not venomous, so keep in mind a popular (albeit not *entirely* accurate) phase: "red next to yellow - kill a fellow" to indicate that if the red and yellow bands of the snake are adjacent to one another (as opposed to black), the snake is likely a venomous coral snake[9].

So, you got bit… Now what?

Start with the ABCs- always. Worry about the airway in coral snake envenomations. Thankfully these are rare in North America. Wound care is the hallmark of snake bite management. The affected limb should be immobilized at the level of the heart and, unlike what you see in the movies, harmful interventions such as tourniquets, ice application, or wound suction should be avoided[12]. Opioids help—and your patient will thank you[13].

The mainstay of treatment for significant envenomation is antivenom administration[14]. It's not the clock, snake ID, or how ugly the bite looks—it's the symptoms. Think hypotension, neurotoxicity, coagulopathy, or rapidly worsening swelling. Some snakebites don't inject venom at all (aka "dry bites"), but early on, there's no reliable way to know. Cytotoxic effects can be sneaky and delayed. Debunking a few myths:

Time since bite: Sure - it's helpful for understanding disease progression, but it doesn't dictate who gets antivenom. If a patient shows systemic symptoms, antivenom should be considered no matter how long it's been. No symptoms after hours of observation? You might just be looking at a dry bite, and those patients can often be managed conservatively[15].

Snake species: While helpful for anticipating the type of venom (neurotoxic vs. hemotoxic), you shouldn't delay treatment waiting for a positive ID. Pit vipers and coral snakes have different effects, but you're treating the *presentation*, not the snake. When in doubt, empiric antivenom is fair game if systemic signs are present[12,15].

Available products include the newer CroFab (ovine-derived) and older Anavip (equine-derived) for pit viper bites[9]. Unfortunately, coral snake antivenom remains less readily available but is essential for confirmed coral snake bites[8]. Initial dosing for pit vipers typically involves 4-6 vials for both children and adults, with additional dosing based on clinical response[5]. Clinicians should remain vigilant for allergic reactions during administration, although premedication with antihistamines is no longer routinely recommended with newer formulations of antivenom[7]. As a side note - these vials tend to cost around $5000 *each*; talk about pricey treatment!

Monitoring and Complications

Patients who receive antivenom, show signs of systemic involvement, or are at risk for compartment syndrome should be admitted for monitoring[6]. Asymptomatic patients may be observed for 8-12 hours before considering discharge[12]. It is crucial to monitor for complications such as compartment syndrome, which, although rare, can threaten limb viability[13]. Additionally, delayed coagulopathy may occur, necessitating follow-up laboratory testing up to 48 hours post-discharge[15]. Serum sickness is another late complication, typically occurring one to two weeks after antivenom administration, and may require steroid treatment[6].

Alternatively, dry bites, in which no venom is injected, represent a substantial proportion of snakebite encounters, characterized by the absence of progressive local symptoms or systemic toxicity. Management of a suspected dry bite begins with thorough observation and reassessment over an 8 to 12-hour period. During this window, serial examinations and basic laboratory testing can help confirm the absence of envenomation. If the patient remains asymptomatic with stable labs and no progression of local findings, antivenom is not indicated! Patient education is key, emphasizing signs of delayed envenomation and the importance of returning for care if symptoms develop[3]. However, when in doubt, early consultation with Poison Control (1-800-222-1222) is recommended for guidance on management[2].

Conclusion

Snakebites present a complex challenge in emergency medicine, requiring rapid recognition and prompt intervention. While most cases involve pit vipers leading to local and systemic effects, coral snake bites demand vigilance for delayed neurotoxicity. Diagnosis hinges on careful clinical assessment and targeted laboratory studies. Management is centered on stabilization, avoidance of harmful "classic" measures, timely antivenom administration, and close monitoring for complications. With a thorough, evidence-based approach, clinicians can significantly improve outcomes for patients suffering from venomous snakebites. Early recognition, smart antivenom use, and close monitoring are key.

References

1. Curry SC, Horning D, Brady P. Snake Envenomation. *StatPearls [Internet]*. 2024.
2. Lavonas EJ, Ruha AM, Banner W, et al. Unified treatment algorithm for the management of crotaline snakebite in the United States: results of an evidence-informed consensus workshop. *Ann Emerg Med.* 2020;75(2):189-201.
3. Gold BS, Dart RC, Barish RA. Bites of venomous snakes. *N Engl J Med.* 2002;347(5):347-356.
4. Seifert SA, Boyer LV, Benson BE, et al. AAPCC database characterization of exposures to venomous animals in the United States, 2001-2005. *Clin Toxicol (Phila).* 2011;49(6):547-553.
5. Bush SP, Ruha AM, Seifert SA. Complications of crotaline snake envenomation: an evidence-based approach. *Am J Emerg Med.* 2022;53:126-132.
6. O'Leary MA, Isbister GK. A review of venom-induced consumption coagulopathy and its treatment with antivenom. *Toxins.* 2014;6(7):2251-2281.
7. White J. Snake venoms and coagulopathy. *Toxicon.* 2005;45(8):951-967.
8. Boyer LV, Seifert SA, Cain JS, et al. Snake envenomations in the United States: review of treatment options and controversies. *Western J Emerg Med.* 2013;14(5):458-464.
9. Dart RC, Seifert SA, Boyer LV, et al. A randomized multicenter trial of Crotalidae Polyvalent Immune Fab (Ovine) antivenom for the treatment for crotaline snakebite in the United States. *Arch Intern Med.* 2001;161(16):2030-2036.
10. Bush SP, Green SM, Laack TA, Hayes WK, Cardwell MD, Tanen DA. Crotalidae polyvalent immune Fab (ovine) antivenom therapy is safe and effective in the pediatric population. *Ann Emerg Med.* 2002;39(6):617-624.
11. Gerardo CJ, Vissoci JR, Evans CS, et al. The efficacy of early versus delayed antivenom administration in pit viper envenomation. *Toxicon.* 2019;157:1-8.
12. Norris RL, Ngo J, Nolan K, Hooker G. Physicians and lay people are unable to accurately identify snakes involved in North American snakebites. *Wilderness Environ Med.* 2005;16(3):160-166.
13. Isbister GK, Duffull SB. Failure of antivenom to improve recovery in Australian snakebite coagulopathy. *QJM.* 2014;107(8):653-658.

14. Lavonas EJ, Schaeffer TH, Kokko J, et al. Crotaline Fab antivenom for the treatment of children with rattlesnake envenomation. *Pediatrics*. 2009;123(3):e484-e491.
15. Tanen DA, Danish DC, Grice GA, Riffenburgh RH. The natural progression of pit viper bite envenomations and the role of antivenom treatment. *Ann Emerg Med*. 2001;37(5):548-553.
16. O'Leary MA, Isbister GK. A review of venom-induced consumption coagulopathy and its treatment with antivenom. *Toxins*. 2014;6(7):2251–2281.