

WILDERNESS MEDICAL SOCIETY PRACTICE GUIDELINES

Wilderness Medical Society Practice Guidelines for the Treatment of Pitviper Envenomations in the United States and Canada

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Introduction

The Wilderness Medical Society convened an expert panel to develop a set of evidence-based guidelines for the prevention and treatment of North American pitviper envenomations. We present a review of pertinent pathophysiology, discuss prevention measures, and therapeutic management. Graded recommendations are made regarding each treatment and its role in management. These guidelines should assist in clinical decision making, but a “cookbook” approach is often insufficient, as each patient is unique and may respond differently to therapeutics. Physicians must use their experience and frequent clinical assessments to apply these recommendations to their individual patients. Consultation with a local toxicologist familiar with envenomations or poison control center is recommended to assist in patient management. These guidelines are for crotaline snakes in the United States and Canada, and should not be applied to other snakes species or geographic regions.

Methods

The expert panel was convened at the 2014 Annual Winter Meeting of the Wilderness Medical Society in Park City, Utah. Members were selected based on clinical and research experience and interest in snakebites and included members with specialties in emergency medicine, surgery, toxicology/toxinology, wilderness medicine, herpetology, and evolutionary biology. Relevant English language articles from 1965 to 2013 were

identified through the PubMed MEDLINE database using search terms (antivenom, copperhead, cottonmouth, crotalid, Crotalinae, crotaline, Crofab, digital dermatomy, envenomation, FabAV, fasciotomy, first aid, pitviper, prevention, rattlesnake, snakebite, treatment, and Viperidae). Studies in these categories were reviewed and level of evidence was assessed. The panel used a modified Delphi consensus approach to develop recommendations graded based on the quality of supporting evidence and balance between the benefits versus risks and burdens for each modality according to criteria stipulated by the American College of Chest Physicians (Table 1).¹

Section 1: Characteristics

VENOMOUS SNAKES IN THE UNITED STATES AND CANADA

The taxonomic family Viperidae contains the Old World taxa (subfamily Viperinae) and the Old and New World pitvipers (Crotalinae), which are venomous snakes with long folding fangs. Crotalinae are pitvipers with heat-sensing facial (loreal) pits, including the North American rattlesnakes (genera *Crotalus* and *Sistrurus*) and cottonmouths and copperheads (genus *Agkistrodon*). *Crotalus* contains almost all rattlesnakes and includes the larger, widely distributed, and more dangerous species. *Sistrurus* includes only 2 small species north of Mexico: the pigmy rattlesnake (*Sistrurus miliarius*) and the massasauga (*Sistrurus catenatus*). Cottonmouths or water moccasins (*Agkistrodon piscivorus*) and copperheads (*Agkistrodon contortrix*) are similar to rattlesnakes but lack a rattle, having tapered, pointed tails instead. All of these pitvipers are generally heavy-bodied snakes with

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Table 1. American College of Chest Physicians classification scheme for grading evidence in clinical guidelines

Grade	Description	Benefits vs risks and burdens	Quality of supporting evidence
1A	Strong recommendation, high-quality evidence	Benefits clearly outweigh risk and burdens, or vice versa	RCTs without important limitations or overwhelming evidence from observational studies
1B	Strong recommendation, moderate-quality evidence	Benefits clearly outweigh risk and burdens, or vice versa	RCTs with important limitations or exceptionally strong evidence from observational studies
1C	Strong recommendation, low-quality evidence	Benefits appear to outweigh risk and burdens or vice versa	Observational studies or case series
2A	Weak recommendation, high-quality evidence	Benefits closely balanced with risks and burdens	RCTs without important limitations or overwhelming evidence from observational studies
2B	Weak recommendation, moderate-quality evidence	Benefits closely balanced with risks and burdens	RCTs with important limitations or exceptionally strong evidence from observational studies
2C	Weak recommendation, low-quality evidence	Uncertainty in estimates of benefits, risks, and burdens; benefits, risks, and burdens may be closely balanced	Observational studies or case series

RCT, randomized controlled trial.

triangular heads, vertically elliptical pupils, keeled dorsal scales, and a single row of subcaudal scales. Although these traits can be found in various nonvenomous snakes, the specific combination of keeled dorsal scales and undivided subcaudal scales is diagnostic for pitvipers in the United States and Canada.² The rattle is unique to rattlesnakes.

Coral snakes are the only other major venomous snakes naturally found in the United States and Canada and belong to the family Elapidae, which also includes cobras, mambas, and kraits. They are slender and identified by the order of their black, red, and yellow (or white) body rings (although they rarely can be melanistic) and do not possess any of the previously mentioned pitviper traits.² Because the management of coral snake envenomation differs from pitvipers, their management is not included in these guidelines.

Field guides and other publications list nearly a hundred subspecies of “dangerous” North American snakes; however, the taxonomy of these snakes remains incompletely defined as ongoing genetic analyses are improving species characterization.³ Some experts suggest the elimination of many subspecific designations altogether.⁴ Clinically, identification to the species or subspecies level is usually unnecessary for guiding treatment—with the exception of Mohave (*Crotalus scutulatus*), timber (*Crotalus horridus*), and Southern Pacific rattlesnakes (*Crotalus oreganus helleri*), among

other taxa that may produce venoms containing potent Mohave or similar presynaptic neurotoxins. Snakebites with this toxin require management that differs from the majority of crotaline envenomations in the United States.^{5,6}

Knowledge of pitviper geographic distributions can help identify a snake (Figure). A picture of the snake can also help with identification by an expert at a later time; however, trying to kill or capture the snake is not recommended as it could lead to a second patient requiring treatment.⁷ If positive identification of a nonvenomous snake by an expert is made, no evacuation is necessary.

Snakes are poikilothermic and tend to seek underground shelter during temperature extremes. Therefore, wild snakes are usually not a threat during cold weather unless their shelter is breached. Field and laboratory studies of temperate pitvipers indicate that they are more active with body temperatures between approximately 25°C and 30°C (77°F–86°F).^{8–10} Snake body temperatures are better correlated with substrate temperature than air temperature, and unshaded substrate temperature can be much hotter than the air on warm sunny days.¹¹

VENOM PROFILES

Some pitviper venoms are known to contain more than 100 different proteins and peptides that produce toxic effects in prey and envenomated humans.^{12,13} The toxic components of snake venom vary greatly and are naturally selected in

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