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In Response to Management of a Pediatric Snake Envenomation After Presentation With a Tight Tourniquet by Bush and Kinlaw

To the Editor:

I read with interest the article by Bush and Kinlaw¹ that described their treatment of a child who suffered a snakebite and had a tight (arterial occlusive) tourniquet placed by a bystander in the field. They described ample clinical evidence supporting envenomation by a crotalid, rather than a neurotoxic snake in this patient. They chose to leave the tourniquet in place for almost 90 minutes from the time of its application while awaiting the preparation and initial administration of Crotalidae Polyvalent Immune Fab antivenom to avoid “the possibility of a bolus effect” when the tourniquet was released. Furthermore, they recommend that this should be standard procedure for patients who arrive at a treatment facility with a tight tourniquet in place. They cite 2 studies^{2,3} that note possible adverse bolus effects from neurotoxic snakes such as cobras and coral snakes to support their reasoning. They also provide an

excellent discussion of local injury by crotalid envenomation and the potential to exacerbate this by tourniquet application. Despite this, they recommend leaving a tourniquet in place.

The primary local effects of crotalid envenomation are caused by vasculopathic tissue damage and the development of compartment syndromes.⁴ I could find no human reports of adverse bolus effects associated with tourniquet release after crotalid envenomation, but there is a significant body of literature describing adverse effects of arterial occlusive tourniquets, especially those that have been in place for longer than 4 to 6 hours.⁵ Prolonged placement of arterial occlusive tourniquets directly leads to tissue ischemia, which likely will be worsened and accelerated by the vasculopathic injury caused by crotalid envenomation. Therefore, the application of an arterial occlusive tourniquet may result in severe local injury in the absence of evidence for prevention of a theoretical bolus effect from a nonneurotoxic snake envenomation.

I believe the authors’ recommendation to “keep the tourniquet in place” should be carefully considered by balancing the type of snakebite, the amount of local injury, and the duration of tourniquet application. In the patient who presents quickly to the emergency department, it may be reasonable to keep the tourniquet in place until antivenom therapy is instituted if the local effects are not severe, if it can be released within a couple of hours of placement, or when there is concern that a neurotoxic envenomation has occurred. However, all efforts should be directed to avoid any excessive application of arterial occlusive tourniquets in patients with crotalid envenomations.

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Disclaimer: The views expressed in this letter are those of the author and do not necessarily reflect the official policy or position of the Department of the Navy, Department of Defense, nor the US Government.

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Backcountry Skiers, Avalanche Trauma Mortality, and Helmet Use

To the Editor:

There is an increasing body of literature and awareness of trauma-associated mortality incurred by avalanche victims.^{1–3} A significant proportion of trauma-related mortality is attributed to head and cervical injuries. The intuitive response has been to emphasize protective strategies, including helmets.

However, recent studies suggest that the benefits of helmet use in resort skiers and snowboarders are mixed. Many report benefits, whereas others suggest the evidence is far from clear. Studies on the benefits of helmet use in backcountry skiers and snowboarders are lacking, and extrapolation from studies of similar user groups is the best information we have at this time.

Climbers and mountaineers who are exposed to rock and icefall are not included in this discussion. Climbing helmets are only standardized for falling objects on the crown, not side, front, rotational, and rear impacts. Human-powered backcountry skiers and snowboarders are the group I am discussing. It is the fastest growing segment of the ski and snowboard industry.

Several recent studies call into question the effectiveness of helmets preventing severe traumatic brain injury (TBI) among snow-sports users. Baschera et al⁴ recently found no decrease in severe TBI among alpine skiers, despite major increases in helmet use. They do mention off-piste users being at increased risk of severe TBI, but they also refer to these participants as “free riders,” which is a different activity than the usual “earn your turns” participant.

Similarly, Christensen et al⁵ found an increasing rate of head injury in skiers and snowboarders despite a doubling of helmet use. This is in the context of ski resort participant numbers being flat for a decade or more. An increasing rate of head injury could certainly be attributed to many factors (increased awareness, diagnostic threshold, high rates of speed with modern equipment), but the finding is concerning and worrisome nonetheless. Importantly, children 10 and younger were

found to have a decreasing incidence of head injury. However, young children are not typically backcountry users venturing into avalanche terrain.

Shealy et al,⁶ in 2008, contended that helmet use in skiers and snowboarders prevented minor injuries, but serious TBI incidence and fatality rate were unaffected by helmet use. However, in 2014, Shealy et al^{7,8} added that helmet use was now having a positive impact in decreasing the potential incidence of serious TBI, yet still had no effect on fatality rate. Mountain fatalities seem to involve high-speed accidents, and it appears that the pattern of death may shift (from head to cervical spine and trunk injuries), but the outcome is likely to be the same.^{6,8}

Analysis of injury mechanisms brings into question the use of helmets for lowering mortality from avalanche trauma. Modern snow-sport helmet technology is made to protect users from impacts at speeds of between 11 and 14 miles/h (18–23 km/h). Avalanches (along with their victims) travel at speeds of 60 to 80 miles/h (97–129 km/h), and take about 5 seconds to reach that speed. Forces of this magnitude outmatch our current helmet standards and likely affect the mortality rate of avalanche victims.

Another issue arises when backcountry enthusiasts take their helmets off to climb, or “skin,” uphill. The rate at which backcountry skiers and snowboarders are caught in avalanches while ascending vs descending is unclear, with opinions ranging widely from 10% to 50% among avalanche experts (informal poll of avalanche forecasters and experts; anecdotal, not studied). The common practice of lashing a helmet to your backpack while ascending and being caught in a slide affords no benefit to the user. Helmets should be worn at all times (including skinning) to have a measurable impact.

A logical question then might be, is there any harm in helmet use? On the surface, this seems to be heretical. But if one digs past the assumptions, shortcomings begin to emerge. If protective equipment takes precedence over education, decision making, and other preventive behavior strategies, then there can be potential harm. Arming oneself with the latest beacon, probe, airbag, Avalung, and helmet are no substitute for practicing safe travel skills, terrain selection, snowpack evaluation, and rescue protocols. I am concerned that our culture that “treats every disease with a pill” all too often chooses gadgets over behavior modification and education. Outfitting oneself with all of the latest technology can bolster risk taking and confidence.⁹ The phrase “energy-drink culture” permeates a large portion of the targeted demographic, and has been used to describe prevailing attitudes toward risk.

It goes without saying that helmets will protect against lacerations, contusions, possibly fractures, and moderate