Efficacy Of Venom Extraction In Adult Snake Bite Victims

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INTRODUCTION AND BACKGROUND

- An estimated 8,000 individuals in the United States are bitten by venomous snakes annually[6].
- Five species of venomous snake inhabit Nevada, all belonging to family, *Viperidae*- sidewinder, Mohave, speckled, western diamondback and Great Basin rattlesnakes[4] .
- Pit viper venom may contain anywhere from 10-100 proteolytic enzymes and nervous system-influencing proteins. Injected quantity varies based on species and snake size, ranging from 10 mg to 1100 mg[3].
- Field care of venomous snake bites has previously focused on hindering the progression of venom from the site of inoculation and includes immobilization, tourniquet placement and suction at the bite site in an attempt to withdraw the toxic substance from the body[3].
- First aid recognizes two methods of suction previously employed for this purpose- oral and mechanical with aid of a negative pressure extraction apparatus such as the Extractor Pump Kit manufactured by Sawyer Products which claims trialed effectiveness for some snake bites[1].
- Much debate exists over the efficacy of suction for snakebite treatment.

QUESTION AND PICO

In adult hikers bitten by poisonous snakes, does negative pressure venom extraction improve tissue survival when compared to no extraction intervention?

P = Adult hikers (age 18 - 65)
I = Negative pressure venom extraction
C = No in-field venom extraction
O = Tissue survival

LITERATURE SEARCH

A literature search was performed using PubMed's MeSH Database. The initial search looked for "snake bite" with the subheading of "therapy. We advanced our search to focus on "suction and extraction" and found 122 results under these parameters. Studies were chosen based off relevance and level of evidence. Other articles were found in the reference sections of these articles.

RESULTS

CITATION	STUDY DESIGN	SUMMARY	LIMITATIONS
Alberts M.B., Shalit M., LoGalbo F.	Randomized control trial involving 8 adult male volunteers evaluating the effectiveness of the Sawyer Extractor Pump in the removal of a mock venom injection.	In conclusion the authors found that venom extraction was able to remove an average of only 2% of venom injected, necessitating a removal of over 3.6L of body fluid to reach clinical effectiveness.	A low sample size (n=8) implies a low power to the study however authors are confident that results would prove similarly with a larger study population. Utilization of mock venom and standardized injection sites limits application of results.
Kanaan N.C., et. al.	Expert panel convened by the Wilderness Medical Society. The panel used a modified Delphi consensus approach to develop recommendations based on the quality of supporting evidence as reviewed from database articles.	Neither oral nor mechanical suction should be employed as a field treatment for pit viper envenomation. Suction attempts may lead to further bacterial inoculation and abscess formation leading to further tissue destruction.	Expert panels are inherently lower quality evidence than randomized clinical trials or reviews. Panelists admit that their findings may not be easily extrapolated to envenomation by other species of snake.
Reitz C.J.,Goosen D.J., Odendaal M.W., Visser L., Marais T.J.	Randomized Control Trial of Rabbits using a Ven Ex cutting and suction apparatus. The rabbits were placed in a control group and Ven Ex treatment group and injected with radioactive Egyptian cobra venom.	In contrast to our other studies, the authors concluded that the trauma from the Ven Ex cutting and suction apparatus decreased the mortality of rabbits versus the control group. After doubling the dose of venom injected, all rabbit cases died with or without the use of an extractor.	A small sample size (n=16) which was prone to type I error. The use of Egyptian cobra venom is not standardized to encompass all cases of snake envenomation. Lastly, they didn't split cases of cutting versus suction as independent factors leading to increased survival.
Holstege CP	Case Study following a 7-year-old boy who was bitten by a copperhead snake with a suction device applied to the bite site.	Patient presented to the emergency 20 mins after the application of the suction device. Figure 1 illustrates an envenomated leg that shows a well-circumscribed area of ecchymosis that correlates to the suction device cup. Significant skin injury is shown to the region that is associated with the suction device.	This is only a single patient's experience with the use of a venom suction apparatus. This study cannot be applied to a population but does show some of the direct injuries that may be caused by suction of a envenomation.
Bush, S. P., et. al.	Prospective crossover randomized control trial of 10 pigs. All pigs received *Crotalus atrox* venom injections in one hind leg, then were randomized to receive Extractor treatment for 30 minutes or no treatment. Group treatments were alternated at 14 days using the opposite hind leg. Swelling and leg circumference were measured and compared using the paired t-test	This study found that the Extractor provided no effect with regards to actual extraction of venom from the injected site. Furthermore, 2 Extractor-treated cases developed tissue necrosis, suggesting that use of this device may promote injury.	A low sample size (n=10) implies a low power to this study. Utilization of porcine models decrease external validity when applying these results to humans.
Senthilkumaran, S., et. al.	Case study following two patients who performed oral suction on victims of cobra bites. After developing ageusia following oral exposure to the venom, subjects were followed for nine days until taste sensation returned.	The case authors found that loss of taste sensation following oral exposure to cobra venom was temporary, and different sensations (sweet, salty, sour, and bitter) returned over the course of nine days. The rapid resolution of the ageusia is likely attributable to peripheral nerve ending damage rather than damage to the taste buds, which would take longer to heal.	The low sample size (n=2) of this case study implies a low power. The mechanism of taste loss was only conjectured rather than directly studied. These cases were both in India and may lask external validity due to differences location, snake species, demographics, or general hygeine associated with the snake bite locations.

DISCUSSION / CONCLUSIONS

Following snake bites and envenomation, victims can suffer local enzymatic destruction of skin and soft tissue, neurotoxic effects, or even cardiovascular depression in more lethal cases[3]. One popular field treatment of snake bites is venom extraction utilizing suction devices. However, randomized control trials and case studies explored here demonstrate the ineffectiveness of these extraction devices. Venom extraction attempts only removed 2% of the mock venom injected into adult male volunteers, indicating that at least two-thirds of a victim's blood must be removed to extract a clinically effective amount of venom. Two of the studies demonstrate direct damage caused by the extraction devices on top the devices' ineffectiveness. Although these studies had few subjects, the devices' propensity for harm and inability to aptly extract enough venom provided sufficient evidence to recommend against their use. One study examined the effects on responders who used oral suction to remove the venom from snake bites. These subjects developed temporary ageusia, demonstrating that both parties can suffer harm from this initial treatment. The only study supporting the use of extraction devices following envenomation suffered from type I error due to low power and did not individualize treatment techniques between the control and experimental groups.

The Wilderness Medical Society recommends against venom extraction as a field treatment for pit viper envenomation, and these studies support that recommendation. These studies demonstrate as a whole that extraction devices are ineffective at removing venom from the bite wound and may increase injury following their use. None of these studies assessed large sample sizes; therefore, further research with more powerful study designs is necessary to accurately assess the effectiveness of extraction devices. Future research should also include more diverse demographic groups to ensure external validity of the results and subsequent application as field treatment recommendations in the case of snakebite victims.

Figure A

References

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