



The approach to the treatment of venomous and poisonous arthropod bites and stings in ancient medicine: A narrative review

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Abstract

Objective: Arthropod bites and stings have always been of interest to humans; therefore, researchers have always been interested in their prevention and timely treatment. Considering the brilliance of ancient Iranian physicians, especially Avicenna, this study was conducted based on their views on diagnosing and treating venomous arthropod bites and stings.

Methods: This study is a narrative review conducted by surveying sources, especially *The Canon of Medicine*, and searching for the keywords "bites," "stings," "poisonous," "venomous arachnids," and "insects" as well as the diagnosis and treatment of bites and stings. The study was conducted in 2022 and in Kashan and Kerman universities of medical sciences. Sampling method was based on the study objective. The collected data was then summarized.

Results: To diagnose the bite or sting, the clinical manifestations of the patient, local symptoms in the bite or sting site, and the classification of the venomous arthropods, such as spiders, wasps, scorpions, etc., are used. Venom suction and using medicinal plants and ointments of mineral compounds were proposed as treatment methods.

Conclusion: Therapeutic methods and the use of herbal and mineral compounds are widely mentioned in *The Canon*. There are a lot of connections and harmony between modern and conventional medicine, in the clinical description of bites and stings as well as their diagnosis, but more research is suggested on treatment methods.

Keywords: Venom, Insect, Arachnid, Arthropod, Envenomation

Introduction

Arthropods are the largest phylum in the animal kingdom in terms of diversity and number of species. Due to their morphological and physiological potential, they have adapted to most aquatic and terrestrial environments (1). Many of them, especially Hexapoda (insects) and Arachnida classes, are closely connected to human life (2). Arthropods can affect human health by transmitting diseases (3). In addition to inflicting economic damage, arthropods transmit many pathogens to humans and livestock, mechanically and biologically (4). Many arthropods, such as cockroaches, termites, bedbugs, and mites, are essential from a public health perspective (5). Many arthropods are considered venomous and poisonous animals because they use their venom to defend against natural enemies or kill prey.

It is estimated that there are 1.7 million species of animals. Among these 15%, spread among different groups, are poisonous or venomous. Many of these venomous animals belong to the arthropod phylum (6).

Arthropods have been equipped with chemical substances and compounds over their long evolutionary path for two main reasons: to defend themselves against enemies and use them to hunt and feed (7). Among animals, no group has as many chemical defense methods as arthropods. Arthropod self-defense, especially against predators, has been the subject of extensive research, and various experts have researched and investigated this field (8). Venomous arthropods deliver their venom to the victim's body in two forms. The first is the active form, which is the venom injection into the human or animal body using an injection device or apparatus, such as stingers, pedipalps, and hypostomes (9). The second form is passive or inactive, which is the excretion of toxic secretions from different parts of the animal, which is primarily defensive and inflicts damage through contact with a human or animal body (10). There are two categories of defense materials in arthropods. Some defense materials are produced by specific endocrine glands (glandular compounds); the rest are substances



that have no glandular origin (non-glandular compounds) and are stored in the blood, stomach, or other parts, inside or on the body's surface.

Glandular compounds may be divided into injectable and non-injectable secretions. The injectables include venoms that scorpions and wasp stings inject, chilopods or centipedes' mandibles, and spiders' chelicera or mouthparts (11). However, the non-injectables have no connection with the injecting organs. Glandular defense includes: exocrine, excretory, spraying, reaction, and tracheal glands (12-17). Poisonous and venomous arthropods have received more attention in the last one or two decades because people have suffered from their bites and stings since ancient times. However, with technological advances, other properties of the venom of these animals have been recognized by humans. Venoms and poisons are significant sources for discovering compounds applicable to targeted therapies. Each toxin has different components that have possible applications in producing advanced drugs to save human lives and the production of insecticides that are healthy for the environment (18-22).

Due to its climatic diversity and geographical extent, Iran has been a natural habitat for many venomous and poisonous arthropods. These animals have been known for the potential damage caused by their bites and stings from the distant past. Therefore, prevention or treatment of their bites and stings have been addressed in ancient Iranian medicine. The traditional and ancient medicine sources contain relatively detailed discussions on treating bites and stings and repelling and killing venomous arthropods. Therefore, the purpose of this study was to critique and analyze the sources on methods of diagnosis and treatment in ancient and historical medicine.

Methods

This study is narrative review research conducted by searching for the keywords "biting" or "bite," "stinging or sting," "venomous animals," "poisonous insects," "bees," "wasps," "scorpions". The study was conducted in 2022 and in Kashan and Kerman universities of medical sciences. Sampling method was based on the study objective. These signs include wounds, local bleeding, blisters, blackening of tissues (necrosis), redness, hematuria, insomnia, difficulty in urination, and intoxication and its various symptoms, including wounds, pain, and bleeding. We also searched for treating poisonous animal bites and insect stings with plants and mineral compounds. All the above searches were conducted in Persian and English sources of websites related to reliable journals in scientific databases, such as Web of Science, ScienceDirect, Ovid, Google Scholar, PubMed, Scopus, and SID. *The Canon of Avicenna*, *Environmental Toxicology*, *History of Medicine in Iran*, scorpion identification books, and articles from 1984 to 2023 were surveyed, and references were selected

based on the study's objectives. In this study, the PRISMA guidelines were followed to include and exclude resources. Based on the type of our study, a total of 122 sources, including seven books and 115 articles, were searched. Finally, according to the title, objectives, method, findings, and study discussion, 36 references, including four books and 32 articles, were selected. Figure 1 shows the search method and selection of articles to be included in the study. The stinging, biting, and venomous factors that were introduced in *The Canon of Avicenna* are presented in the table as the phylum of arthropods, their class and order, and the structure of the venom injection device or the biting agent organ of each order of these animals. Then, the study data were extracted, summarized, and interpreted.

Results

The results showed that out of the four classes of arthropods that have venomous biting and stinging species, only three of them have been introduced as venomous stinging and biting species, and out of a total of about 14 orders with venomous and poisonous arthropods, seven species have been introduced as biting (23). Table 1 shows arthropods' venomous and biting orders along with their bite symptoms and prevention methods based on traditional Iranian medicine (24,25).

In traditional Iranian medicine, about 34 venomous species of arthropods have been introduced, including seven species of insects and centipedes, 13 species of solpugids, five species of spiders, and nine species of scorpions. Among the venomous insects, we can mention bees, including honey bees, large bees, and small bees, winged and biting ants, centipedes and beetles, and biting water bugs (24).

Solpugids are mainly categorized based on color, such as white, spotted, red, fluffy yellow, Egyptian, smoky black, and glossy, and categorized based on shape, such as dorsal hump, grape-shaped, bee-shaped, ant-like, humpback, round, or bitter-vetch-seed-shaped, or categorized based on their leg size and even having wings. Spiders are differentiated mainly by their size or by the location of the bite, such as four jaws (chelicera or mouthparts), as well as fatality and danger. Scorpions have been identified according to their color, such as white, yellow, red, earthy black, gray, green, golden, vinaceous, and smoky, or based on the degree of danger and lethality (25-28).

Discussion

The bite and sting of venomous arthropods have caused suffering and injury to humans since the distant past. Therefore, this subject has been addressed in ancient medicine in countries such as Iran. One of the primary sources of ancient Iranian medicine is *The Canon of Avicenna*. This source has been the focus of attention of physicians from the distant past until contemporary

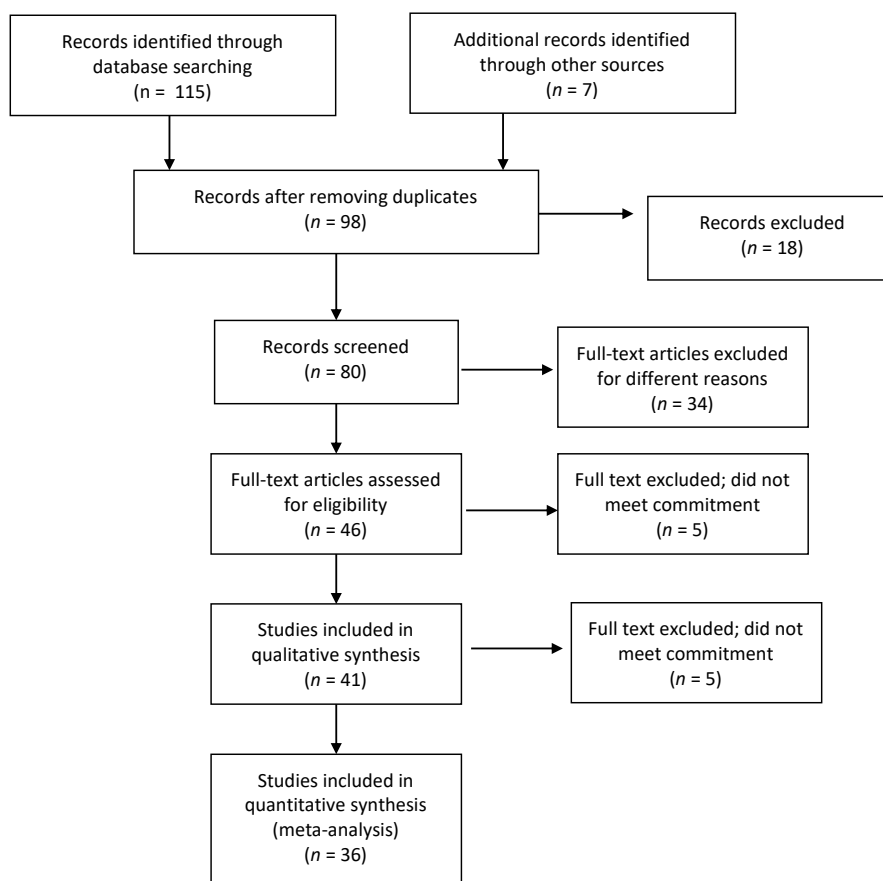


Figure 1. PRISMA flow diagram of search method and selection of articles to be included in the study

times (29,30). Our study showed that many arthropods have been considered venomous animals in Iran since the distant past. A relatively specific description of clinical effects has been given for each of them, which, in some cases, such as treating scorpion stings, are relatively consistent with modern medicine. For example, in the case of *Hemiscorpius lepturus* stings, it has been reported that it is more common in Khuzestan. Usually, people do not feel much pain when they are stung. In the following days, the person has blood disorders and skin color changes and may develop jaundice. The size of the tongue increases, and the site of the sting becomes a purulent lesion. Bloody urine (Hematuria) occurs, which may eventually lead to the patient's death (26-28).

The clinical manifestations of *Hemiscorpius lepturus* stings, described by Iranian researchers over the past three decades, are consistent with the views of the great Iranian scientist Avicenna, recorded more than a thousand years ago (31,32); this shows the advanced level of medical knowledge in that time and even before that. Also, Avicenna's writings about the morphology and habitat of venomous arthropods and their sting site or their chelicera are accurate (33,34).

In traditional Iranian medicine, removing the venom of any animal is the priority because by removing the venom, even in small quantities, the pathophysiological

effects of the venom can be reduced. Venom sucking has been of particular importance, and patient management began with the suction of venom. Regarding suction, some conditions have been suggested. Suction should be done so that as much venom is extracted from the bite or sting site as possible, or the bite or sting site should be phlebotomized for the venom to come out with the blood to save the victim's life. Alternatively, dry cupping could be applied at the bite site to remove blood and venom (26-28).

In modern medicine, in the case of honeybee stings, removing the stinger with a credit card or a scalpel is recommended, as pulling the stinger is prohibited because the remaining venom may be injected. Because the sting of wasp species does not remain in the victim's body, the above removal method is unnecessary. In traditional medicine, it was recommended to heat the sting site, warm the sting site with water vapor, or for the patient to take a steam bath to induce profuse sweating (Table 1). In contrast, in modern medicine, ice and cold compresses are recommended to control the local reactions at the bite or sting site of bees, wasps, fire ants, black and brown widow and recluse spiders, and scorpions. The topical use of vinegar and salt is also recommended to reduce the pain of fire ant stings (35).

In Hymenoptera stings, in addition to traditional treatments such as cold compresses and vinegar and salt

Table 1. Venomous arthropod stings and bites according to order, common name, local and systemic clinical manifestations, and first aid and treatment based on ancient Iranian medical sources

Order	Common name	Local and systemic clinical manifestations	Treatment
Scorpions	Scorpion	A-Species with neurotoxic venom: Severe and sudden pain, swelling, and stiffness at the site of the sting, reduction in body temperature, chills, sweating, thick tears, bloating, belching, axillary swelling, thickening of the tongue, numbness and tremor of lips, pallor, anal prolapse, infection, fainting and anesthesia, and, in severe cases, death B- Species with hemotoxin or cytotoxic venom: No initial pain; the day after the sting, depression and discoloration of the face and jaundice, swelling of the tongue, bloody urine (hematuria), pus or necrosis of the sting site and increase in heart rate (tachycardia), and eventually fainting and death	A- Use of medicinal plants orally, such as eating garlic with wine or garlic with walnuts, drinking wine, eating horseradish and basil, bitter lettuce juice, chicory juice, beer B- Esfand (wild rue or Syrian rue, African rue) <i>Peganum harmala</i> to reduce pain at the sting site, heating the sting site with water vapor, taking a steam bath to induce sweating, heating the area
Arachnida	Black or brown widow	A- Species possibly with neurotoxic venom: flatulence, shooting pain in the body, coldness of hands and feet, swelling of the genitalia, severe pain and redness at the site of the bite, and difficulty urinating. B- Species possibly with cytotoxic and hemolytic venom: bloody urine (hematuria), nose bleeding (epistaxis), rectal bleeding, bloody vomiting (hematochezia), and bleeding from lungs (hemoptysis), and gums.	Rubbing of antidotes such as lettuce juice and red sandalwood on the bite site. It is helpful to taking fresh goat milk, butter, tin-e-maxtum-ol-malek, mah Parvin (Habb-e-jadwar), purslane and portulaca juice, <i>Plantago psyllium</i> and its mucilage, and other heat suppressors such as chicory juice, lettuce juice, pumpkin juice, and cucumber juice.
Solifugae	Solifuge	Symptoms include severe pain, whitening of the bite site, swelling of the head and face, and insomnia.	The best and most basic treatment for solpugid bites is desert mint (scientific name: <i>Bioss nepeta ispahantica</i>), gavshir or asl-ol-javshir), clover and shepherd's musk (mashk-e-choopan, scientific name: <i>Achillea millefolium</i>)
Geophilomorpha	Centipede	It has a low-toxicity venom that wears off after a short time.	The flower of barvagh (scientific name: <i>Eremurus spp.</i>) is an antidote for centipede bites. Rubbing of salt and vinegar on the bite site
Hymenoptera	Wasps, bees, and fire ants	Pain, blisters, redness, swelling, and swelling of the sting site. Large bee stings cause convulsions and weakness of the knees.	Sucking on sting site, taking marjoram, dried coriander and cooling juices and drinks, and ice suppository. It is helpful to use <i>Origanum majorana</i> by sprinkling the cold extract on the sting site and covering it with a linen cloth soaked in cold water.
Hemiptera	Water bugs	Severe pain and redness of the bite site	In treating aquatic insect bites, the suitable antidotes are drugs for treating cold temperament and drugs and antidotes for treating solpugid bites.
Coleoptera	Beetles	Severe pain and redness at the bite site	Suitable antidotes are drugs for the treatment of cold temperament and drugs and antidotes to treat solpugid bites.

mixture, it is recommended in modern medicine to clean the sting site with soap and water, apply topical or injectable lidocaine with or without epinephrine to reduce pain and take oral corticosteroids, antihistamines, and analgesics, except nonsteroidal anti-inflammatory drugs (NSAIDs). Subcutaneous or intravenous epinephrine is used in case of systemic reactions. Traditional medicine's effectiveness in managing these complications is unclear (35).

The Canon of Avicenna contains recommendations for treating venomous arthropod bites or stings and reducing their side effects. These recommendations are based on reducing the pain of the bite or sting site by taking stinking assa (from plant *Ferula asafoetida*) resin, eating garlic with wine or garlic and walnuts, warming the bite site, and taking a steam bath to induce heavy sweating to relieve pain (Table 1). The oral medications recommended for scorpion sting treatment include bitter lettuce juice, desert chicory juice, or beer and eating anything that suppresses heat, especially in cases with high inflammation (28).

The article's authors found no recommendation in

modern medicine to drink alcohol to treat arthropod bites or stings. Cleaning the bite site with isopropyl alcohol after debriding the bite site is recommended in the treatment of bed bugs (36) and lice infestations (37).

The therapeutic effect is not known in the recommendations in ancient medicine. Therefore, these cases should be considered with caution unless their efficacy is confirmed by research. *The Canon* mentions 13 species of solpugids with different colors as venomous animals that cause pain and discomfort by biting. In contrast, in new articles and sources, solpugids are not considered venomous arthropods (23,38).

However, solpugids may still bite as they have large chelicera. Four bite holes may be seen in the bite site. For this reason, their bite is also called a four-jaw bite. Of course, considering that spiders are venomous, and in addition, they have two chelicerae, each with one fixed and one mobile finger, their bite site may be mistaken for solpugid bites. For differential diagnosis, if four relatively large bite holes are seen side by side and there are no symptoms indicating intoxication, it is caused by

a solpugid. However, if clinical manifestations of venom accompany four relatively small bite holes, the bite is related to spiders (26,28).

In ancient Iranian medicine, in some cases, data is very specific on venomous arthropods and the treatment of their stings or bites. However, other texts give general recommendations for treating venomous animals. Therefore, the therapeutic protocols suggested by these resources can be considered by researchers as subjects for future research. A clinical trial can show an accurate assessment of the effectiveness of old treatment methods (26,27).

Implication for future research

Using new science and the development of mono and polyvalent antivenoms against different arthropod toxins, the possibility of detoxification in the first minutes and hours of arthropod bites and stings has become possible. New chemical drugs have a miraculous effect on managing neurological and digestive complications. New techniques such as extracorporeal removal and hemodialysis also significantly manage hematological symptoms in these cases (35).

These new treatments target both early and late symptoms after the bite or sting, including anaphylactic reactions, serum sickness syndrome, and consequences such as disseminated intravascular coagulation disorder, saving the lives of many patients from the risk of certain death or permanent complications.

In fact, with the progress of science and access to drugs with high efficacy in managing arthropod bites and stings, traditional treatments such as sucking the wound, rubbing herbal medicines on the bite or sting site, or eating plants are not used anymore due to the possibility of drug toxicity and the uncertainty of their potency and effective dose. However, they can still be the subject of extensive research using modern scientific methods.

Conclusion

Venomous and poisonous arthropod stings and bites have long been considered a health problem in tropical and subtropical countries, including Iran, and the treatment of stings and bites that cause severe injuries and even death has had a special place in ancient Iranian medical texts. This research was conducted by examining the therapeutic approach for the treatment of arthropod bites and stings in traditional Iranian medicine. Parts of this knowledge are still applicable today. Therefore, we can still use the experiences and knowledge of the past after careful study and reassessment. Like other ancient texts, these sources have unreliable and even scientifically incorrect parts, and they can be neither accepted nor rejected completely. It is recommended that similar studies be conducted on traditional medical sources of different countries, including Ayurveda of India, Chinese

medicine, etc., to assess their correctness and inaccuracy by conducting modern scientific methods and preventing futile debates between groups who are for and against them.

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Supervision: Rouhullah Dehghani.

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Competing Interests

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Ethical Approval

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