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COCHRANE CORNER

Cochrane Corner: How Effective Are Interventions for Reducing Symptoms and Signs Resulting from Jellyfish Stings?

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ABSTRACT

This is the third Cochrane Corner in the *International Journal of First Aid Education*, provided to you by Cochrane First Aid. Like each Cochrane Corner, it summarizes the findings of a Cochrane systematic review. It is meant to give first aid trainers, laypeople providing first aid, and guideline developers direct access to highly relevant first aid-related evidence tailored to them, which they might otherwise not have access to. Additionally, this Cochrane Corner is accompanied by a visual abstract that highlights the key findings. Each corner also has a practitioner's perspective to help readers apply and question the findings.

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This Cochrane Corner is based on a review investigating the benefits and harms associated with interventions aimed at treating jellyfish stings in adults and children. The updated review was developed by the Cochrane Pain, Palliative and Supportive Care Group and is published in the Cochrane Database of Systematic Reviews 2023, Issue 6, DOI: 10.1002/14651858.CD009688.pub3 (see www.cochranelibrary.com for information). Since Cochrane reviews are regularly updated as new evidence emerges and in response to feedback, the Cochrane Database of Systematic Reviews should be consulted for the most recent version of the review.

Both the Cochrane Corner and the visual abstract were checked by Dr. Richard G McGee, the corresponding author of this Cochrane review.

Keywords: systematic review; jellyfish; cochrane corner; first aid; treatment

BACKGROUND

Jellyfish stings are common in temperate coastal regions, where humans typically come into contact only with surface-dwelling jellyfish species. Stings are produced by specialized stinging cells on the jellyfish called nematocysts. Nematocysts are triggered by physical or chemical stimuli (or both), after which a barb is fired, and venom is injected into the person. Depending on the number of nematocysts that may discharge and the potential toxicity of the venom, a jellyfish sting may produce a range of signs and symptoms of varying severity, including pain, redness, and itching of the skin. Some jellyfish species can cause more serious reactions, such as Irukandji syndrome, which may include pain in the abdomen, back, or chest, as well as increased heart rate, increased blood pressure, cardiac phenomena, and, rarely, death.

Many treatments have been suggested for the symptoms and signs of jellyfish stings, in order to deactivate the attached nematocysts, neutralize the venom, and provide symptomatic relief (including pain relief) and supportive care. Applying heat or cold may relieve pain due to the inactivation of the venom. Topical treatments include attempts to deactivate undischarged stinging organelles. Treatments injected directly into the body, such as magnesium sulfate to treat neurotransmitter abnormalities associated with Irukandji syndrome, and pressure immobilization, which lacks a theoretical basis but is used in first aid, have also been suggested. Currently, for the treatment of jellyfish stings, the Australian Resuscitation Council and Red Cross recommend (1) the use of vinegar in tropical Australia or a cold/ice pack if vinegar is unavailable, and (2) hot water for stings in non-tropical regions or for obvious bluebottle stings. However, the effectiveness of different treatments is still unclear.

Research question

What are the benefits and harms associated with the use of any intervention, in both adults and children, for the treatment of jellyfish stings?

Literature search

The review authors (McGee et al., 2023) looked for randomized controlled trials (RCTs) and quasi-RCTs comparing any intervention to treat stings from any species of jellyfish stings to another active intervention, placebo, or no treatment. The main outcomes of interest were a clinically significant reduction in pain within six hours (i.e. at least 50% of maximum possible pain relief, or a 50% reduction in pain intensity, or interpreted as clinically important by the study authors), and adverse events due to the treatment. Other relevant outcomes included clinically significant reductions in pain at different time points, cessation of pain at the end of treatment, retreatment with the same intervention or another intervention at different time points, dermatological signs up to one week after the sting, requiring supportive care, hospital treatment, and all-cause mortality at one month after the sting.

The authors searched for studies published up to October 2022 in the Cochrane Central Register of Controlled Trials, MEDLINE, Embase, and Web of Science. They also searched clinical trial registers, grey literature, the reference lists of included studies, and other relevant publications, and contacted content experts and authors of papers in the field.

RESULTS

The authors identified nine relevant studies, including three quasi-RCTs and six RCTs, with a total of 574 participants. Five studies were conducted in Australia, three in Hawaii (USA), and one in California (USA) using jellyfish imported from Malaysia. Jellyfish studied were bluebottles (Australia), Indonesian sea nettle, and box jellyfish that either can (*Carukia* from Australia) or cannot (Hawaiian and major box jellyfish) cause Irukandji syndrome. Participants were either stung accidentally or were healthy volunteers exposed to stings in a laboratory setting.

Four studies in 213 participants compared the effect of **applying heat versus cold** to accidental stings by bluebottles (two studies in Australia) or box jellyfish (one study in Hawaii, one study in Australia). Based on the very low-certainty evidence from these studies, it remains uncertain whether the application of heat (using a hot pack or hot water) compared to the application of cold (using a cold or ice pack):

- reduces or stops pain;
- causes any harm (such as burns or temporary redness around the area of application);
- reduces skin reactions (such as itchiness, red marks, or rashes);
- reduces the need for retreatment or switching to alternative treatment.

When looking at stings from bluebottle jellyfish alone, heat compared to cold may reduce pain, but the evidence is very uncertain. Regarding the other jellyfish species, data indicated little or no difference in the number of people who had a clinically significant reduction in pain, although this finding was again very uncertain.

Topical treatments were assessed by four studies in total. One USA study involved accidental stings by Hawaiian box jellyfish, whereas three studies included people who volunteered to be stung in a laboratory setting (one study in California using Indonesian sea nettle, one study in the USA using Hawaiian box jellyfish, and one study in Australia using bluebottles).

Topical treatments included freshwater, seawater, Sting Aid (a commercial product), meat tenderizer, isopropyl alcohol, ammonia, acetic acid, liquid lidocaine, and sodium bicarbonate. Only two of the four studies reported outcomes relevant to the review, for a total of 160 participants. Based on the very low-certainty evidence from these studies, it is uncertain whether the application of topical treatments to the skin on and around the sting site:

- reduces or stops pain
- causes any harm. In one study, treatment using ammonia was withdrawn because one participant had a first-degree chemical burn after this treatment.

None of the studies measured the need for retreatment, the need for switching to an alternative treatment, or skin reactions.

One study looked at the effect of **intravenous injection** with magnesium sulfate versus placebo but did not measure any of the *a* priori outcomes set by the reviewers. None of the studies looked at the effectiveness of **pressure immobilization**.

Reviewer's Conclusion

Due to the very low certainty of the evidence, the effectiveness of any of the treatments identified by and evaluated in this review remains uncertain.

Implications for first aid practice and research

This review identified a very limited number of studies, varying in treatment settings and jellyfish species. As the stings from different jellyfish species produce symptoms of varying severity, treatment will depend on the species. Although the evidence was very uncertain,

the data from the included studies did not refute the treatment recommendations of the 2010 Australian Red Cross guidelines (applying heat to non-box jellyfish stings in non-tropical Australia and applying vinegar to box jellyfish) and the 2000 International Life Saving Federation guidelines (applying vinegar to box jellyfish).

Future research is needed to determine which treatments are most effective for treating signs and symptoms of jellyfish stings of a certain species. Future research may consider other interventions for which no evidence is currently available, including pressure immobilization bandages or the specific effectiveness of vinegar or salt water. If interventions are trialed in a beach setting, they should be appropriate to a real-life setting in which they could realistically be applied by a volunteer first responder without first aid training. In addition, future studies should measure clinically important pain reduction and the cessation of pain, preferably through the use of validated measurement tools for pain and recognized interpretations of pain reduction. Last, even though the measurement of adverse effects due to the treatment is challenging, study investigators should clearly report whether events are due to the sting or the treatment or whether this information is unknown. Finally, in future updates of this review, it might be worth considering non-randomized studies alongside RCTs.

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McGee, R. G., Webster, A. C., Lewis, S. R., & Welsford, M. (2023). Interventions for the symptoms and signs resulting from jellyfish stings. *Cochrane Database of Systematic Reviews*, Issue 6. Art. No.:CD009688. DOI: https://doi.org/10.1002/14651858.CD009688.pub3

Cochrane Corner Response: Key Roles to First Aider Interventions for Jellyfish Stings and a Case Report

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We praise Cochrane First Aid's efforts in sharing this Cochrane Review on such an important topic with scarcely available scientific evidence. We understand the objective of the question "how effective are interventions for reducing symptoms and signs resulting from jellyfish stings" as Cegolon (2013) reviewed a similar question with comparable results. The mechanism of action of hot versus cold water immersion was the prevailing hypothesis by which heat treats cnidarian (which jellyfish are a part of) envenomation, where temperatures are used to inactivate venom components. This is based on the evidence from in vitro and in vivo studies, which suggest that cnidarian venoms from all classes in the phylum breakdown with heat. Some have suggested that the mechanism by which heat provides pain relief is unrelated to the inactivation of venom components. The alternative explanation proposed is that hot water immersion has a direct modulatory effect on pain receptors, leading to a reduction in perceived pain (Cegolon, 2013; Wilcox & Yanagihara, 2016). The only treatment to neutralize the venom is Australian anti-*Chironex fleckeri* serum. Whilst the review provides important information, context remains that could be significant to this subject.

BACKGROUND

More than 150 million cases of cnidarian envenomation are estimated to occur worldwide every year, although this is thought to be just the tip of the iceberg (Cegolon, 2013). As a minor injury pre-hospital occurrence, the events are highly underreported globally (state, national, and world) as they are reported by lifeguards and who are not connected to a wider data collection center like the "International Shark Attack File – Florida Museum" https://www.floridamuseum.ufl.edu/shark-attacks/.

There are three main types of *cnidae* (stinging apparatus of the phylum Cnidaria): nematocysts, ptychocysts, and spirocysts, with many variations among distinct species in which one or more types may be present. Cnidarian all "sting," but the nematocyst is the main and most important type, they present as pressurized capsules containing a harpoon-shaped thread, located predominantly in the tentacles, and can reach up to 30 m. If triggered by osmosis or contact, toxins can be injected deeply into the victim through individual microneedles. In their original function, these structures captured prey, but any contact will trigger the mechanism of discharge and inoculation of the venom (Pereira, 2018).

A sudden increase in the cnidarian population at a location is called a jellyfish bloom. They are natural phenomena, but other factors may have contributed in recent decades, such as the increase in ocean water temperature and changes in beach environments. Together with more visitors to the beaches, those injuries are expected to increase. An outcrop in the summer of 2011/2012 on the coast of Paraná (Brazil) caused more than 20,000 injuries by the species *Chrysaora lactea*, according to data collected by the local Fire Department

(Ministério da Saúde, 2024). This jellyfish bloom has frequented Southern Brazil and seems to repeatedly happen every year. In contrast with the strong increased frequency of injuries, a search at Datasus system (Health Ministry data disease center) using the International Code of Disease X26 over 10 years (2013–22) revealed only eight deaths attributed to contact with marine animals and plants (including jellyfish).

Usually, jellyfish stings receive no treatment other than being washed with water and removal of the stingers. This is because in most cases, itching caused by the sting does not last longer than a couple of hours and the person does not need further assistance. In this situation, the person affected does not need further aid. So, whatever first aiders use to treat the symptoms and signs of jellyfish stings, they will be providing comfort. Although other cnidarians can cause serious envenomation associated with systemic phenomena and risk of death, they are much rarer. Among these are the Portuguese man-of-war (*Physalia physalis*) and the cubomedusas (*Tamoya haplonema* and *Chiropsalmus quadrumanus*), with reports of deaths in humans after envenomation (Pereira, 2018).

The most frequent cnidarians around the world mainly cause localized injuries, manifested by intense local pain, swelling, and irregular, rounded, or oval erythematous plaques (solid, raised, often red, and associated with the irritation) that are rarely linear (unlike species that cause serious envenomation), and more rarely, with small marks of tentacles.

Systemic phenomena (respiratory and cardiovascular manifestations) are even rarer and most of the envenomation will be mild in severity, although the local pain may be excruciating. A small proportion of victims develop systemic reactions because of the venom, which can cause intense muscular pain, cardiac arrhythmias, low cardiac output, and shock. Two risk factors of more severe envenomation include children, due to the greater compromised body area, and larger specimens like *O. sambaquiensis* and *C. lactea*.

As highlighted in the Cochrane Review a vast majority of envenomation has extremely favorable outcomes and can be controlled by iced marine water compresses and a popular use of vinegar baths. Exceptional injuries may be more serious, with influential factors such as the age of the patient and the size of the cnidarian.

FIRST AIDER KEY POINTS

As envenomation generally occurs in the water, lifesaving needs to be the highest priority. Drowning may occur due to a sudden drop in the victim's water competency. Other variables may play a role in that encounter to cause drowning. The distress provoked by sudden pain and/or the fear of contact with the unknown can lead to a waste of physical effort in swimming. Additionally, the neurotoxic venom of certain species can decrease motor function response or promote a loss of common sense or direction while still in the water. An anaphylactic reaction leading to shock is another possibility, although rarer.

Anaphylaxis jellyfish case report

The most frequent jellyfish in Southern Brazil mainly cause localized pain and skin plaques. As an example, a 3-year-old female bather presented an erythematous, irregular plaque on the left forearm after contact with a jellyfish, along with intense facial swelling and facial flushing. A first aider identified the severity of the situation and called for advanced medical help. The lungs had a vesicular murmur, wheezes, snorts, and pink and spumous secretion in the airways with intercostal retraction. A medical doctor, called by first aiders, administered subcutaneous adrenaline (0.1mg/kg) and hydrocortisone intravenously (10mg/kg) with total recovery in a few minutes. The manifestations of anaphylactic reactions are distinct from those of envenomation, and prompt and adequate care is fundamental in these situations. As a sequela, allergic phenomena are not part of the toxic effects, but the consequences can be serious. The various spectra of an allergic-type I reaction (anaphylaxis) may be triggered, causing acute urticaria, angioedema, and anaphylactic reaction, with extremely serious consequences.

FIRST AID EDUCATION POINTS TO CONSIDER

The following first-aid education points complement this discussion based on our experience in Brazil (Haddad, Szpilman, Szpilman, 2018).

Prevent & Prepare: Jellyfish Injury

1. Neoprene clothing, suitable for diving, is useful to avoid venom inoculation. Lycra clothing can also reduce the number and extent of injuries from our experience with open-water swimming in Brazil. These measures are especially useful for water sports competitors, especially long-distance swimmers who are more at risk for exposure to jellyfish. The parts of the body most affected are the legs and arms, followed by the trunk.
2. Stay away from the animal: It is important to remember that the tentacles of certain species can reach a considerable distance, and therefore, approaching them should be avoided. Even when appearing dead and thrown on a beach, the tentacles can stick to the skin and inflict injuries, as the nematocysts are discharged even after the animal's death.
3. When swimming in places known to have jellyfish, cover your body with mineral oil or similar (this helps prevent the tentacles from sticking to the skin). After storms and undertows, a swimmer can suffer injuries when encountering loose tentacles that remain floating in the water. Therefore, after these events, people should avoid swimming in places where there are reports of jellyfish and Portuguese man-o´-war appearing.
4. Use gloves to remove tentacles attached to the victim (if possible) to prevent secondary injury to the first aider.

Early Recognition: First aid has five main objectives:

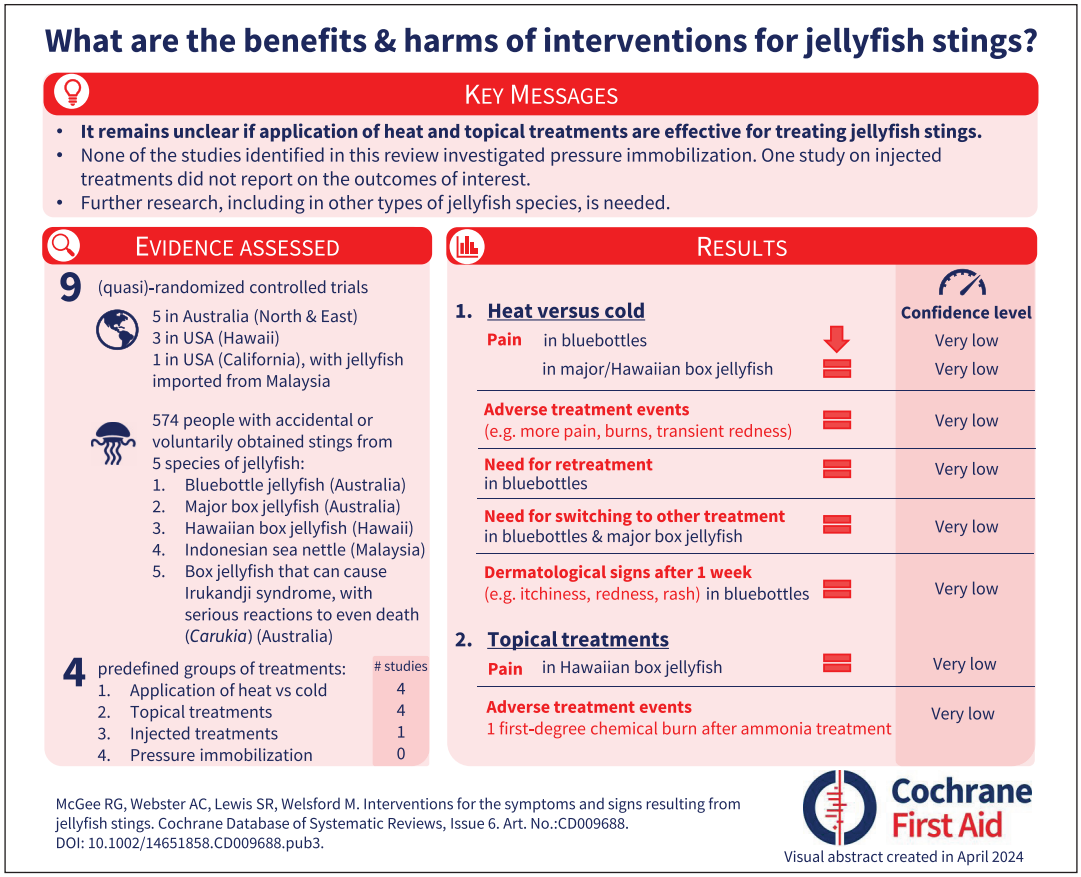
1. **Remove yourself/victim from the water immediately, avoiding drowning** – Stay as calm as possible and signal for help (ex. hand-signal to a lifeguard). Be aware of the Drowning Chain of Survival (Szpilman, 2014).

First Aid *This Cochrane Review found a lack of research on treatment outcomes, so the Brazilian Lifesaving Society has developed best practices into its protocols based on local hazards.*

2. **Minimize the discharge of nematocysts into the skin** – Efforts by the victim, still in the water, to free themselves from the adhered tentacle pieces, usually increase nematocyst discharges. Only after reaching dry land, preferably using gloves/ forceps, should the tentacles adhered to the skin be carefully removed. Wash with abundant salt water (avoid fresh water as it increases the nematocyst discharged) and alternate with 5% acetic acid (vinegar) to "stop" nematocysts that have not discharged, for 10-20 minutes.
3. **Reduce the effects of the inoculated venom – cold vs hot pack**. Preferably apply cold saltwater compresses (due to the anesthetic effect). If it is impossible to rely on ice-cold saltwater, apply artificial ice packs (cold packs) wrapped in cloth.
4. **Relieve pain** – cold or hot pack and topical analgesia.
5. **Control systemic repercussions**. Differentiate an allergy case. A patient who presents sneezing, snoring, and wheezing in the lungs and difficulty breathing may be having an allergic reaction. This can be life-threatening and even cause death in cases of anaphylactic shock or when the airways are obstructed due to swelling in the throat. In this case, adrenaline (aka epinephrine) must be used subcutaneously while accessing advanced medical care, due to the risk of death. In milder cases, oral antihistamines and corticosteroids are used, always under medical supervision. In late lesions, apply a thin layer of corticosteroid cream/ ointment (betamethasone) two to three times a day.

Advanced Care Call immediately for advanced assistance if there is wheezing in the lungs, difficulty in breathing, skin lesions away from the affected area, disorientation, or unconsciousness.

VISUAL ABSTRACT



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