

# Aquatic Antagonists: Indirect Nematocyst Envenomation and Acute Allergic Contact Dermatitis Due to Nudibranchs

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It is well-known to swimmers, divers, and beachgoers that coelenterates such as the Portuguese man-of-war (*Physalia physalis*), true jellyfish such as the box jellyfish, sea anemone, true coral, and fire coral can inflict painful and sometimes fatal stings. As a result, these organisms are avoided by humans and most sea creatures; however, indirect contact with the skin may occur. For example, coelenterates may release toxic substances into the marine environment, leading to sensitization in swimmers even without contact with stinging tentacles.<sup>1</sup> Subsequent contact with the same or cross-reacting substance may lead to a severe episode of acute allergic contact dermatitis. The Portuguese man-of-war, true jellyfish, sea anemone, true coral, and fire coral (a hydroid) all contain nematocysts within their tentacles. Portuguese men-of-war may have tentacles up to 27-m long with as many as 1 million nematocysts.<sup>2</sup> During severe storms, tentacles may break away from the primary organism and envenomate unsuspecting individuals. These reactions may be just as severe as attacks with live jellyfish, especially in sensitized individuals.

Interestingly, the stinging nematocysts of coelenterates are not feared by all. In fact, there are several organisms that utilize these stinging cells for defense. In particular, *Tremoctopus violaceus*,<sup>3</sup> a member of the blanket octopuses, tears off tentacles of *P physalis* for offensive and defensive purposes. Nudibranchs, also called sea slugs, take advantage of stinging nematocysts in a different and fascinating way. They

actually incorporate the nematocysts as outgrowths on the body after eating portions of the Portuguese man-of-war tentacles. This review focuses on this nudibranch method of defense and how it pertains to human envenomation.

## Classification

Nudibranchs are of the phylum Mollusca and class Gastropoda, but unlike other organisms in this class, they lack protective shells. Nudibranchs of the suborder Aeolidina and family Aeolidiidae are of most interest to this discussion. The term *sea slug*, frequently used for descriptive purposes, by no means describes the beauty of these creatures. Many of these organisms are brightly colored (Figure 1), which most often relays a message of unpalatability to potential predators.<sup>4</sup> Others are well-camouflaged to avoid potential predation. In addition to the potential for indirect nematocyst envenomation, many of these



**Figure 1.** An aeolid nudibranch with exquisite colors (*Cerberilla ambonensis*). Note the hornlike cerata on the dorsal aspect of the organism. Photograph courtesy of Gary Cobb, PhD, Cofounder, [www.nudibranch.com.au](http://www.nudibranch.com.au).

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**Figure 2.** The nematocyst-filled cerata are easily seen in this photograph, albeit this species would be difficult to see in the marine environment (*Anteaeolidiella indica*). Photograph courtesy of Gary Cobb, PhD, Cofounder, [www.nudibranch.com.au](http://www.nudibranch.com.au).



**Figure 3.** Dorsal and lateral cerata of this brightly colored nudibranch (*Coryphella species*). Photograph courtesy of Alexander Semenov, BS, MV Lomonosov Moscow State University, Russia.



**Figure 4.** Close-up of cerata (*Coryphella species*). The nematocysts are clearly visible as white spots on the tips of the cerata. Photograph courtesy of Alexander Semenov, BS, MV Lomonosov Moscow State University, Russia.



**Figure 5.** One of the nudibranchs responsible for severe indirect nematocyst envenomation (*Glaucus atlanticus*). This species may grow to 35 to 40 mm in length. Photograph courtesy of Gary Cobb, PhD, Cofounder, [www.nudibranch.com.au](http://www.nudibranch.com.au).

aeolid nudibranchs secrete ichthyodeterrent allelopathic compounds, such as longifin and nakafuran-9, to ward off potential fish attacks.<sup>5</sup>

### Nudibranch Adaptability

Aeolid nudibranchs are capable of avoiding nematocyst envenomation by coelenterates because of a number of adaptations, including behaviors that limit contact with prey, specialized vacuolated cells forming a protective layer in the epithelium, a protective cuticle lining the mouth, and copious protective mucous secretions specific to the prey of the nudibranch.<sup>6</sup> Interestingly, the chemical composition of the mucous secretion may change if the type of prey is new to the nudibranch.

### Pathway of Envenomation

Once ingested by the nudibranch, a portion of the stinging nematocyst remains undigested, passes through the digestive system, and is incorporated into dorsal and lateral outgrowths on the body. These outgrowths are known as cerata (Figures 2 and 3). *Ceras* (plural *cerata*) is derived from the Greek term *keratos* meaning horn. This term exemplifies the horny protuberances on the back and sides of the aeolid nudibranch. Following transport to the cerata, the stinging nematocyst is stored in a sac at the tip of the cerata, which is known as a cnidosac (Figure 4). If contact with potential prey or human skin occurs, the nematocyst will fire just as a true coelenterate stings, delivering its venom. Two species of nudibranchs in particular, *Glaucus atlanticus*

(Figure 5) and *Glaucilla marginata*, feed on the tentacles of *Physalia* species. The clinical appearance of humans who have had contact with these nudibranchs is similar to Portuguese man-of-war envenomation,<sup>7</sup> without the typical long linear wheals most often seen with hydroid stings. Acute allergic contact dermatitis occurs with burning, erythema, urticarial papules, potential vesicle formation, and postinflammatory hyperpigmentation when healed. Treatment of stings includes potent topical steroids, cool compresses, and antihistamine therapy. A sunscreen with jellyfish sting protective lotion is available at local dive shops and is marketed to help prevent envenomation from various coelenterate stings. It would seem likely that this lotion also may help to prevent indirect coelenterate stings.

### Conclusion

Despite various methods developed by nudibranchs to avoid predation, these mollusks without protective shells are not devoid of danger. Sea slugs may succumb to other carnivorous nudibranchs, various fish including wrasses and puffer fish, several species of crabs, sea spiders, and nemertine worms. As with the Portuguese man-of-war, true jellyfish, and other coelenterates, the aeolid nudibranchs are better left for visual admiration rather than touching. The incorporation of stinging nematocysts into the cerata of nudibranchs is one of the truly unique methods of adaptation and survival in the animal kingdom.

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