Marine Envenomations

Kamna S. Balhara, MD*, Andrew Stolbach, MD

KEYWORDS

• Jellyfish • Irukandji syndrome • *C fleckeri* • *Physalia physalis* • Spiny fish • Stingray • Marine envenomation • Marine antivenom

KEY POINTS

- Marine fauna vary widely by geographic location. Antivenoms exist for stonefish, box jellyfish, and sea snake envenomation but vary in availability in North America.
- Bleeding and infection are the most significant complications of stingray exposure.
- Severe marine envenomations may cause hypertension, paralysis, or rhabdomyolysis.
- Box jellyfish, Irukandji jellyfish, sea snakes, blue-ringed octopi, and cone snail exposure can be fatal, but they do not typically naturally occur in North America. North American fatalities from *Physalia physalis* have been recorded, and spiny fish represent a large number of reported exposures in the United States.
- Acetic acid (4%–6%) application and hot-water immersion are advised for jellyfish exposures in North America.

INTRODUCTION

The marine environment poses many hazards for humans, including a myriad of organisms that have developed toxins for the purposes of defense or feeding. Organisms such as sea snakes, spiny fish, and certain species of jellyfish have the potential to cause significant human morbidity and, occasionally, mortality. The American Association of Poison Control Centers' 2010 and 2011 annual reports document approximately 1800 aquatic exposures in the United States alone each year, of which almost 500 annually were treated in health care facilities; however, this likely grossly underestimates the number of marine envenomations per year because it only takes into account those that were reported to poison control centers.[1,2]

Marine venoms comprise a wide array of toxins and are usually mixtures of high-molecular-weight proteins and low-molecular-weight compounds (histamine, bradykinin, indole derivatives). Although the pathophysiology of many venoms and the associated signs and symptoms remains unclear, in many cases envenomation leads to mast cell degranulation, disruption of cell metabolism, interference with neuronal

Department of Emergency Medicine, Johns Hopkins University, 1830 East Monument Street, Baltimore, MD 21287, USA
* Corresponding author. 1830 East Monument Street, Suite 6-100, Baltimore, MD 21287.
E-mail address: kbalhar1@jhmi.edu

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transmissions, and myocardial depression. Subsequently, envenomations can cause significant pain, dermatitis, paralysis, cardiovascular collapse, and respiratory failure (Box 1). The appropriate treatment of many marine envenomations remains controversial, because much of our knowledge is based on animal models and human case reports.

The aim of this article is to highlight certain venomous vertebrate and invertebrate organisms that are either ubiquitous in causing morbidity or have the potential to cause mortality. The organisms to be considered are enumerated in Boxes 2 and 3. The epidemiology, clinical presentation, venom pathophysiology, and potential guidelines for the treatment of each of these organisms is reviewed. Although antivenoms are available for some of the deadlier marine creatures, none are approved by the Food and Drug Administration (FDA), and they vary in their availability in North America. Treatment guidelines and antivenoms are summarized in Tables 1–3.

VERTEBRATES

Stingrays (Class Chondrichthyes)

Epidemiology

Stingrays of the class Chondrichthyes are large, flat, cartilaginous fish with wings and a long, tapered, whiplike tail with bilateral retroserrated edges (Fig. 1). The tail is equipped with 1 to 6 sharp barbs and a ventrolateral groove containing venom glands that coat the spine with venom and mucus. They are found in tropical and subtropical waters worldwide; 11 species are found in the United States. One review described 17 fatalities from stingray exposure, two of which occurred in Australia.[3]

Venom

Stingray venom contains amino acids, serotonin, 5′-nucleotidase, and phosphodiesterase.[4] It is heat-labile and cardiotoxic in animal models. The heat lability of this venom has important implications for local analgesia at the site of injury.[5] Studies in Brazilian freshwater stingray venom in animal models have revealed toxins that may interact with membrane phospholipids, cause leukocyte rolling, and exert a potent vasoconstrictor effect.[6,7] The venom may also have proteolytic, gelatinolytic, and hyaluronidase activities, explaining severe wound necrosis and contributing to the local damage already caused by the sting.[8]

Presentation

These fish burrow under sand in shallow water, and most injuries occur from unintentional contact or unfouling fishing equipment. When the wings are stepped on, the tail

Box 1
Presentation pearls

Common Mechanisms of Morbidity and Mortality in Marine Envenomations

Stingray	Exsanguination
Spiny fish	Cardiotoxicity, neurotoxicity, hemolysis, edema
Sea snakes	Paralysis, respiratory failure, rhabdomyolysis
Box jellyfish (*Chironex fleckeri*)	Cardiotoxicity, catecholamine surge
Irukandji (*Carukia barnesi*)	Severe hypertension
Portuguese man-of-war (*Physalia physalis*)	Respiratory failure, hypotension
Cone snails	Paralysis, respiratory failure, cardiotoxicity
Octopus (*Hapalochlaena maculosa*)	Paralysis (without change in mental status), respiratory failure, hypotension