Palytoxin Poisoning via Inhalation in Pediatric Siblings

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Keywords: Palytoxin, Pediatric, Inhalation, Aquarium, Zoanthids

INTRODUCTION

Zoanthid corals are often found in sea water aquaria. Touching the zoanthid corals results in palytoxin poisoning in patients with skin injuries and also through intact skin [1, 2]. Several cases of palytoxin poisoning have occurred during cleaning of aquariums by inhaling a water aerosol where toxin is dissolved [3, 4]. Herein, we report a case of inhalational toxicity affecting pediatric patients, as well as involving multiple individuals following cleaning of an aquarium. To our knowledge, this represents the first case of elevated lactic dehydrogenase (LDH) following inhalational exposure and the third case of leukocytosis.

CASE REPORT

A three-year-old boy and his two-month-old sister presented to the emergency department, both febrile after vomiting at home. The three-year-old also presented with tachycardia (heart rate 120 beats per minutes), cough and sleepiness whereas the two-month-old did not have cough, the cough reflex is unreliable at this age. Both patients had no known allergies. Since the children’s parents were also ill with vomiting and a feeling of being hungover, an initial diagnosis of unspecified food poisoning was made.

The symptoms occurred after their aquarium attendant washed the coral in the tank with hot water. A short while after, the parents were both vomiting...
DISCUSSION

Currently, there are no restrictions on the importation of toxic marine organisms into the United States if they are not ingested. Records regarding Zoanthidea are also not required. In some cases, Zoanthidea are not purchased at all, but are merely contaminants growing on rock or coral (e.g., frags). Recently, specimens of Zoanthids collected from home aquarium stores were analyzed and found to be highly toxic with palytoxin [5]. Palytoxin \((C_{129}H_{223}N_{3}O_{54})\), first isolated in 1971, is one of the largest and most complex natural products and is the second deadliest toxin known to man with an LD\(_{50}\) of 300 ng/kg in mice, 2 mg of toxin could kill 300,000 mice [5–7]. A toxic dose in humans may be about 4 μg. However, there are no reliable quantitative data on acute toxicity in humans. In our case, both identification of the toxin and quantification of levels were not performed, and palytoxin was implicated based on the exposure to Zoanthids and clinical symptomology. Palytoxin is one of the only marine toxins that are toxic to humans via ingestion, inhalation or dermal exposure. The toxin is heat stable and boiling or hot water used in cleaning aquaria does not inactivate the toxin.

Palytoxin binds to Na, K-ATPase, resulting in transformation of the sodium pump into a non-specific ion channel for monovalent cations causing a wide spectrum of secondary pharmacological actions [8]. More specifically, an increase in sodium may stimulate calcium-independent superoxide anions and oxidative stress, leading to cellular death [9]. The toxicity can be severe affecting multiple organ systems and takes place after a short-time of exposure at very low concentration. Clinically, patients can develop paresthesia, hypertension, dysgeusia, nausea, vomiting, diarrhea, rhabdomyolysis, cardiac dysrhythmias, respiratory depression, coma and death [10, 11].

Most cases involving aquarium Zoanthids have involved dermal exposure [1, 2, 12, 13]. While inhalational toxicity from marine aerosols is well known, the first case of inhalational toxicity from aquaria was reported in 2008, a second case was reported in 2010, and a third case in 2012 [3, 4, 14, 15]. This case report represents the fourth case of inhalational toxicity incidental to aquarium Zoanthids.

Very few data is available regarding inhalational toxicity. In 2003, 2006 and 2008 outbreaks of inhalational toxicity from blooms of algae occurred in Europe and the Mediterranean sea. All those affected needed medical attention for high fever, coughs and wheezing [16, 17]. Therefore, exposure to aerosolization results mostly in respiratory illness, fever, mild dyspnea, bronchoconstriction, cough, sore throat, headache, rhinorrhea, lacrimation, expectoration, myalgia, arthralgia, dermatitis, odynophagia, fatigue, dry throat and, occasionally, conjunctivitis. There are anecdotal reports in online marine aquarium forums of individuals poisoned via inhalation from cleaning organisms or
aquaria under steaming water. However, there are only a few published case reports of inhalational palytoxin toxicity from exposure to aquarium Zoanthids. The cases are summarized in Table 1.

In our case, the cleaning attendant became sick first, followed by the parents, and then the two children. The parent’s complaint of feeling hungover is consistent with previous reports of poisoning from contact with aquarium Zoanthids. In one case, the patient exhibited dizziness, slurred speech, and glassy eyes [1]. Clearly, the symptoms in the adults in this case were of lesser severity than that in the children. Additionally, the two-month-old female developed symptoms earlier than her brother and was considered more sick. This would indicate greater susceptibility. However, the paucity of reported cases in children does not permit a comparison of inhalational toxicity from palytoxin in adults and children.

Creatine kinase levels of approximately 1000 U/L are suggestive of rhabdomyolysis. Creatine kinase levels were normal in the three-year-old, but mildly elevated in the two-month-old. However, elevated LDH in our patients may be indicative of mild rhabdomyolysis which was asymptomatic. Rhabdomyolysis is one of the most dangerous complications of palytoxin poisoning because it can lead to acute renal failure. Both patients also had hyperkalemia which is an early and fast-rising manifestation of rhabdomyolysis and mild hyperphosphatemia.

While all the cases were presumptive, the appearance of symptoms in five individuals simultaneously after cleaning an aquarium is highly suggestive of palytoxin toxicity.

Although animal studies have shown that vasodilators, such as papaverine and isosorbide dinitrate, can be used as antidotes if injected directly into the heart immediately following exposure [18], there is no specific antidote for palytoxin poisoning. Treatment is supportive. Both patients received hydration and were closely monitored in the PICU.

**CONCLUSION**

Zoanthids are commonly sold by pet stores and found in home aquaria. Precautions should be taken as palytoxin can travel in water vapor and cause poisoning by inhalation. Cases of palytoxin toxicity via inhalational route, while rare, do occur. Exposure is characterized by vomiting, leukocytosis, elevations in lactic dehydrogenase, sometimes creatine kinase, and a febrile syndrome.

**Author Contributions**

Martha M Rumore – Substantial contributions to conception and design, Acquisition of data, Analysis and interpretation of data, Drafting the article, Revising it critically for important intellectual content, Final approval of the version to be published

Blaine M Houst – Substantial contributions to conception and design, Acquisition of data, Analysis and interpretation of data, Drafting the article, Revising it critically for important intellectual content, Final approval of the version to be published

**Guarantor**

The corresponding author is the guarantor of submission.

**Conflict of Interest**

Authors declare no conflict of interest.

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