Cnidarian (coelenterate) envenomations in Hawai‘i improve following heat application

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Abstract

A retrospective review of medical records from 113 patients with cnidarian stings in western O‘ahu, Hawai‘i, was conducted for the 5-year period 1994–98. The most common clinical feature was acute local pain, but cases of anaphylaxis or anaphylactoid syndrome and a persistent or delayed local cutaneous syndrome were also documented. Six cases resembled the Irukandji syndrome described from northern Australia, characterized by severe pain and signs of catecholamine excess, including muscle cramping, elevated blood pressure, diaphoresis, and tremor. Treatment with heat application, usually by means of a whole-body hot shower, appeared to provide better clinical improvement than parenteral analgesics or tranquilizers, particularly in patients with the Irukandji-like syndrome. The heat sensitivity of one or more of the Carybdea alata venom components might account for the effect of heat treatment.

Methods

WCCHC is the largest health care facility on the western or leeward coast of the island of O‘ahu, Hawai‘i, and an area of intensive ocean-related activity. Marine envenomations in Hawai‘i, particularly marine box jellyfish (Carybdea alata) and Portuguese man-of-war (Physalia sp.) envenomations, result in thousands of annual medical encounters via call to WCCHC. Medical encounters from 1 January 1994, through 31 December 1998, were reviewed to identify cases compatible with box jellyfish sting injuries. A case was defined as immediate local pain, itching, or swelling with no other identified source. Data on demographic information, environmental circumstances, type and extent of injury, treatment, and outcome were extracted from the full medical records.

Results

The computer-based search of WCCHC medical records yielded 1113 individual cases with ICD-9 codes of 998.5 or E905.6 between 1 January 1994 and 31 December 1998; 172 cases were identified as cnidarian

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stings, and an additional 5 were marine-acquired stings (probably due to cnidaria (no identified contact with fish, sea urchin, or coral), for a total of 177 stings.

Of the 177 definite or probable cnidian stings, the original medical records were obtained for 113 (63.8%); other records were generally in archival storage. The age of patients ranged from 15 months to 49 years, with a median of 17 years. Twenty-three (20.4%) of the patients were female, 90 (79.6%) were male.

Cnidian stings were more common during the summer months, June through September (126/177), and on the 8th–10th days following the full moon (26/113) consistent with the appearance of C. alata along the leeward coast of O'ahu (Landy Blair, Ocean Safety and Lifeguard Service O'ahu, Hawai'i, USA, unpublished observations).

Most of the cases presented with immediate pain and/or itching localized to the sting site(s) (Table 1). Regional pain or numbness was sometimes associated with the local pain. Six cases had an illness resembling the Irukandji syndrome; clinical features are detailed in Table 2.

Heat treatment was used in 60 cases, 53 by means of a whole-body hot shower and 7 by localized hot packs or hot wet compresses. Of the cases treated with heat, records of 42% (25/60) contained sufficient outcome information to be analysed for results of treatment (Table 3). Parenteral analgesics were used in 15 cases and included meperidine, butorphanol, morphine sulphate, and ketorolac, with or without hydroxyzine or promethazine; an oral analgesic (paracetamol) was used in one case. Parenteral lorazepam (a benzodiazepine) was used in 5 cases. The percentage of analysable cases was 25% (4/16) for analgesic treatment, 60% (3/5) for parenteral benzodiazepines (Table 3).

For overall treatment of cnidian stings, heat was superior to parenteral analgesics (odds ratio [OR] = 11.5, P = 0.008), particularly if the analysis is restricted to hot shower treatment (OR = 22.0, P = 0.0485). For treatment of the Irukandji-like syndrome, heat once appeared to be superior to analgesics (OR undefined, P = 0.40) or benzodiazepines (OR undefined, P = 0.10). All 4 episodes in which analgesics or benzodiazepines failed to provide relief were cases of Irukandji-like syndrome. There was no difference in outcome between heat and analgesics for 92% of local cases. Differences in outcome were not seen between heat and the combination of epinephrine plus antihistamines for anaphylaxis/anaphylactoid syndrome (P = 1.0, data not shown).

In 10 cases, the duration of a hot shower and outcome were recorded (Table 3, footnote). None of the patients was hospitalized; there were no deaths.

Discussion

The various clinical presentations observed among the victims in this series have previously been described for cnidian envenomation elsewhere (Auerbach, 1995; Burnett & Calton, 1987a; Burnett, 1991). The most serious Hawai'i cases involved anaphylaxis or an Irukandji-like syndrome.

Irukandji syndrome has been described from cases in northern Australia and was associated with the sting of a small cubozoan, Carukia barnesi (Fenner et al., 1986). It was postulated (Fenner et al., 1988) that this syndrome was present in Hawai'i, based on a case with abdominal and low-back pain (Kizer, 1984). However, the cases in the present study (Table 2) resemble the classically described Irukandji syndrome even more closely. Carukia sp. have not been reported from Hawai'i; it is not known whether other cnidarians such as Carybdea sp. may cause this classic Irukandji syndrome, muscle cramping, back spasm, tremor and/or diaphoreses were observed within 1 h of the sting, in the patient cases summarized in Table 2. Thus, regardless of the aetiology, it appears that Irukandji syndrome or a very similar disorder occurs in Hawai'i.

Symptomatic treatment was frequently employed in this series, particularly antihistamines and analgesics. Virtually none of the cases treated with antihistamines had outcome information, precluding useful comparison with other treatments. This may have been because antihistamines were often given after clinical improvement, upon discharge from the ED, with no further period of observation.

Heat treatment (generally in the form of a whole-body hot shower, administered within 2 h of the sting) was most often (in 92% of cases) associated with relief of pain, agitation, dyspnoea, or markedly elevated blood pressure. Although this treatment appears superior to analgesics or benzodiazepines, the large number of unanalyzable cases renders any conclusions tentative.

Outcomes were better after hot showers than after focal hot packs (Table 3), although few cases were treated with the latter. If the benefit of heat treatment depends on the amount of heat transferred to the dermal site of venom deposition, then it may be relevant that the skin surface temperature attained by a 44°C hot-water irrigation (42-42°C after 10 s) is greater than that attained by a topical sodium thioulsolate hot pack (39.6°C peaking at 2.5 min) (P. Bjorkman, unpublished observations at the WCCHC ED). Thus, it appears that hot showers would transfer a greater quantity of heat than hot packs [cf., the same phenomenon underlying the use of a circulating hot water bath for external rewarming of hypothermia victims (Danzl et al., 1995)]. Further support for the dermal heat hypothesis comes from the duration of the hot shower. The only case in which a hot shower reportedly failed to provide relief was one with 10 min of treatment, the briefest recorded duration (Table 3, footnote).

There is limited information from other investigators on the effects of heat treatment for cnidian stings. Pecca et al. (1997) found that soaking the affected part in warm salty water (8 cases) was associated with the resolution of pain from Carybdea marsupialis stings from the Italian Adriatic. Auerbach (1995) mentions (without citation) the reported benefit of a hot shower among 'beach patrol members'. In contrast, Burrell (1989, 1991) found that hot-water immersion for an experimental Physalia (Atlantic specimen) sting resulted in proximal lymphatic dilatation and erythema, but no relief of pain. This case has been the basis for warnings against heat treatment (Stein et al., 1989; Burnett, 1991; Fenner et al., 1993; Auerbach, 1995).

There is a report of clinical deterioration following focal-water application in an apparent Chironex fleckeri sting (Barnes, 1966); proceedings of a conference (Burnett et al., 1987; Auerbach, 1991; Holmes, 1996). However, it is difficult to interpret this case report, because the same patient rapidly improved after

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Table 1. Cnidarian envenomation syndromes at Wai'anae, Hawai'i, 1994–98 (n = 113)

<table>
<thead>
<tr>
<th>Presentation signs and symptoms</th>
<th>Number of cases</th>
</tr>
</thead>
<tbody>
<tr>
<td>Local pain and/or itching</td>
<td>59</td>
</tr>
<tr>
<td>Local pain with regional neurological symptoms</td>
<td>3</td>
</tr>
<tr>
<td>Anaphylaxis/anaphylactoid syndrome</td>
<td>11</td>
</tr>
<tr>
<td>Irukandji-like syndrome</td>
<td>6</td>
</tr>
<tr>
<td>Mild systemic symptoms</td>
<td>7</td>
</tr>
<tr>
<td>Persistent/delayed cutaneous syndrome</td>
<td>21</td>
</tr>
<tr>
<td>Other</td>
<td>2</td>
</tr>
<tr>
<td>Unclassifiable</td>
<td>4</td>
</tr>
</tbody>
</table>
fleckeri heat-sensitive venom components and a heat-based treatment in patients to avoid thermal injury, to pretreated crude venom (A. A. Yanagihara, unpublished observations). This experimental evidence suggests that at least the haemolytic component(s) of C. quecirrha crude venom from both C. fleckeri and Chysaora quinquecirrha (BURNETT et al., 1996).

There is limited published information about other cnidian venoms. A haemolytic fraction of Carybdea marsupialis venom was inactivated by heat, but there was no testing at a temperature suitable for human treatment (ROTTINI et al., 1995). Similarly, Atlantic Physalia crude venom is inactivated by heating to 60°C for 5 min (LANE, 1960), although some factors are heat stable (BURNETT & CALTON, 1977).

Table 2. Characteristics of Irukandji-like syndrome cases at Wai‘anae, Hawai‘i, 1994–98 (n = 6)

<table>
<thead>
<tr>
<th>Case</th>
<th>Clinical presentation</th>
<th>BP (mmHg)</th>
<th>RR (breaths/min)</th>
<th>P (beats/min)</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Stung on chest, intense pain, shaking</td>
<td>110</td>
<td>22</td>
<td>10</td>
</tr>
<tr>
<td>B</td>
<td>Stung on R arm, back pain and spasm, throat pain, diaphoresis, shaking</td>
<td>100</td>
<td>20</td>
<td>15</td>
</tr>
<tr>
<td>C</td>
<td>Stung on toes, severe pain, shortness of breath with rapid shallow breathing, marked agitation, combativeness, diaphoresis</td>
<td>170</td>
<td>40</td>
<td>132</td>
</tr>
<tr>
<td>D</td>
<td>Stung on L axillary area, severe pain, violent agitation, diaphoresis</td>
<td>98</td>
<td>30</td>
<td>136</td>
</tr>
<tr>
<td>E</td>
<td>Stung on L shoulder and R ankle, muscle cramping, chest and abdominal pain</td>
<td>106</td>
<td>RR, 26</td>
<td></td>
</tr>
<tr>
<td>F</td>
<td>Stung on L arm and L thigh, severe pain, increase of cough, tremor</td>
<td>118</td>
<td>RR, 20</td>
<td>226</td>
</tr>
</tbody>
</table>

Among persons treated with a hot shower, the outcome (relief/no relief) according to duration of shower was: 10 min, 3/1; 15 min, 4/0; 20 min, 2/0; duration not recorded, 13/0.

Table 3. Outcomes of treatments of cnidarian envenoming at Wai‘anae, Hawai‘i, 1994–98

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Relief</th>
<th>No relief</th>
</tr>
</thead>
<tbody>
<tr>
<td>Any form of heat</td>
<td>23</td>
<td>2</td>
</tr>
<tr>
<td>Hot shower</td>
<td>22</td>
<td>1</td>
</tr>
<tr>
<td>Hot pack/compress</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Analgesics</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Benzodiazepines</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

P, pulse (beats/min); RR, respiration rate (breaths/min); BP, blood pressure (mmHg); R, right; L, left.

Precautions should be observed in the use of heat treatment in patients to avoid thermal injury, to exercise good clinical judgement in placing patients in a setting where monitoring and resuscitation are difficult, and to consider potential contraindications to heat stress [extremes of age, cardiovascular disease, hyperthyroidism, the use of many drugs, and certain other conditions (DANZL, 1988)]. It may be prudent to avoid excessive heat stress by using a focal hot shower to the affected body part when possible, but this has not been studied.

The limitations of this study include its retrospective nature, an unrepresentative study population (people seeking medical care for stings), the absence of a randomized control group, and the restricted medical record availability. Another limitation is the large number of medical records lacking details on circumstances, treatment sequence, and outcome, yielding a small number of analysable cases for several of the treatments.

Nevertheless, the findings on heat, specifically, hot-shower treatment of cnidian stings in Hawai‘i are very encouraging. There is a constellation of circumstantial evidence suggesting that such treatment may be beneficial for both the common acute local-pain syndrome as well as the uncommon Irukandji-like syndrome, and that a greater transfer of heat to an envenomed site is more beneficial, within the limits of physiological tolerance. Furthermore, heat application was not reported deleterious in 60 treatments in this series.

Prospective controlled clinical trials of heat treatment for cnidarian envenomings are warranted. One such trial of beachside treatment in Hawai‘i is currently in progress, using hot packs as a heat source (C. Thomas and S. Scott, personal communication). A study evaluating whole-body or partial-body hot showers would also be valuable. Other studies in progress are attempting to characterize the biochemical properties of cnidian venoms in Hawai‘i, which may yield further insights into specific clinical management. If validated in prospective trials, hot-shower treatment would offer a simple and widely available method of managing these common marine injuries.

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References


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Addendum

A randomized controlled trial (mentioned in the last paragraph of the above text) has recently been published on beachside treatment of stings probably caused by the Hawaiian box jellyfish (*Carybdea alata*) (THOMAS et al., 2001a). Following vinegar dousing, the use of topical chemical hot packs was associated with greater temporary (10 min) pain relief than topical chemical cold packs or control (ambient temperature) packs, although the degree of pain relief was of marginal clinical significance. Note should be made that the subjects of that Waikiki study (sting victims who sought assistance from a lifeguard at the beach) may differ from the Wai‘anae study population (sting victims who sought emergency department care). In addition, there may be significant differences between hot pack application and a hot shower in the skin temperature attained and the duration of heat application (see Discussion above). A companion article (THOMAS et al., 2001b) found no difference in pain relief between the application of sea water, triswater, aluminium sulphate and detergent, or papain solution following vinegar dousing.
