



ORIGINAL RESEARCH

STRETCH: Stinging tree exposures to Cairns Hospital

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Abstract

Objectives: To evaluate the burden of disease, investigate the treatment and response to treatment caused by exposure to stinging tree plants presenting to Cairns Hospital over a 3-year period. Our secondary aim was to examine the benefit from treating such exposures with topical dilute hydrochloric acid (HCl).

Methods: A retrospective chart review of all patients presenting to Cairns ED over a 3-year period because of stinging tree exposure. Symptoms, signs, treatment and outcomes were recorded.

Results: There were 48 presentations, all having immediate pain after contact with the stinging tree, with 87% describing the pain as moderate or severe. Nearly all were stung on limbs (96%). There were 13 different treatments prior to presentation. In hospital, 60% needed opioid analgesia and a median oral morphine dose equivalent of 15 mg. Of the 29 receiving HCl nine patients reported good relief or complete relief.

Conclusions: Stinging tree exposure results in significant presentations to the Cairns ED each year. Pain is immediate and severe and there are no clear first aid or definitive treatment recommendations. Further work is needed to ascertain the best first aid and definitive treatment including a formal trial of dilute HCl.

Key words: *emergency, poisoning, stinging tree, toxicology, toxinology.*

Introduction

The stinging tree (*Urticaceae* family, species *Dendrocnide*) is an Australian shrub or tree that grows to about 1.5 m in height. The *Dendrocnide sp* stinging trees are found in the tropical and subtropical rainforest along the east coast of Australia from the Cape York peninsula in the Far North to as far south as southern New South Wales.¹ There are five *Dendrocnide* species in Australia: *D. moroides*, *D. cordata*, *D. excelsa*, *D. photinophylla* and *D. corallodesme*. In the Cairns region, these plants are known locally as the 'Gympie-Gympie' plant (*D. moroides*) stinging tree.

Worldwide there are 37 species within the *Dendrocnide* genus, and these plants are found in other tropical and subtropical areas of the world such as Asia and the Pacific.

The leaves and stalks of the *Urticaceae* plants are covered in thousands of fine, hypodermic-needle like silica hairs. These hairs are thought to be a defence mechanism against browsing by herbivorous mammalian species. The hairs are made up of a tip, shaft, and a base. Biomineralisation of these hairs with calcium carbonate, calcium phosphate and silica confer stiffness to their structure. With light touch the tip breaks off and a sharp mineralised edge is formed along the

Key findings

- Stinging tree stings were nearly always on limbs and caused immediate moderate or severe pain in most patients presenting.
- Opioid analgesia was administered to 60% of patients with a median oral morphine dose equivalent of 15 mg (range 3–90 mg).
- There is very little literature about these stings, and no evidence-based pre-hospital or hospital management guidelines for patients stung by stinging trees.

shaft. The shaft has a hollow centre containing numerous substances which are injected into the skin.^{2–5} These substances result in immediate and often severe pain, that can last for many hours or days.^{1,3}

There are very limited reports about the Australian experience of *Dendrocnide sp* stings in humans. Most of the published data is either case reports or scientific investigations evaluating the composition of the hairs and toxins that these plants contain,^{6,7} with one case report describing clinical envenomation.⁸

Exposure to stinging trees is a regular presentation to the Cairns Hospital ED and results in a significant burden of disease each year. To date, there is no literature evaluating the burden of disease that these plants cause to public hospital settings or studies defining effective first aid or treatment protocols.

Indigenous traditional treatment was to apply crushed green ants to the sting, releasing formic acid (Dr D Green, Clinical Toxicologist, Cairns Hospital, personal communication). Other advice is to use dilute

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hydrochloric acid (HCl).¹ The Cape Tribulation Tropical Research Station recommends 3% HCl (i.e. dilute) soaks for up to 30 min, followed by waxing the stung area to remove hairs embedded in the skin.⁹

Anecdotal local experience in Cairns had suggested that dilute HCl applied topically may be effective in pain management for treatment resistant cases.

The aim of the present study was to evaluate the burden of disease, investigate the treatment and response to treatment caused by exposure to stinging tree presenting to Cairns Hospital over a 3-year period. As the ED had developed a guideline to manage stinging tree stings, our secondary aim was to examine the benefit from treating such exposures with topical dilute HCl.

Methods

Setting

Cairns Hospital is a major regional hospital in Far North Queensland, 1800 km north of Brisbane. Its geographical catchment extends to an international border with Papua New Guinea and covers over 270 000 km². Its capacity is greater than 500 beds and services a population of 280 000 people. The Cairns ED had 74 729 presentations in 2018/2019¹⁰ with a 4.5% per annum increase in presentations since 2013. Including admissions to the EDSSU, the admission rate from ED in 2017 was 41.5%.

Study design

The present study was a retrospective chart review.

Our study population included all patients presenting to Cairns ED over a 3-year period from April 2016 to July 2019.

Data were collected from the Queensland Health integrated electronic medical record (iEMR), which is used by the Cairns Hospital ED. The iEMR was searched for a discharge diagnosis of 'stinging of skin', 'stinging of nettle', 'plant sting', 'allergic reaction caused by

plant', 'contact dermatitis by plant' and 'accidental poisoning by plant'.

We agreed the definition of a case was: contact with a stinging tree (large, leafed bush or small tree) resulting in presentation to the ED with symptoms.

These patient records were manually searched to confirm the primary toxicology diagnosis.

Data were then entered into a preformatted data extraction tool. Data collected included the total number of cases, age and sex of the patients, yearly case load, geographical location of the sting, pre-hospital management, description of the pain and any local signs, body area affected, pain management in the ED, response to treatment, length of stay, representations of patients discharged and adverse effects to treatments. Those with a new medical record for this presentation, and who gave an address outside Cairns' region were deemed tourists.

Where pain scores were recorded, we divided the pain scores into none, mild (pain score 1–3), moderate (pain score 4–6) and severe (pain score 7–10).¹¹ Where there was no pain score, but a description of the pain was recorded we used these descriptions and/or the analgesia prescribed to assign the severity of the pain. If the documented description of the patient's pain was 'distressed or extremely distressed' and/or the patient was given IV opioids, we deemed that severe pain. If the description of the patient's pain was 'uncomfortable' and/or the patient received oral opioids we deemed that moderate pain; and if the patient was described as feeling uncomfortable and/or the patient only received simple oral analgesia, we deemed that mild pain.

All types and doses of analgesic medications were recorded, as well as the maximal type of analgesia (nil, simple analgesia, paracetamol and codeine 30 mg, oral opioids or parenteral opioids) administered for each patient to achieve adequate analgesia. As different opioid medications (both type and route of administration) were administered, all opioid doses were converted to oral morphine equivalent daily dose

as described by the ANZCA Faculty of Pain Management¹² to standardise the number of opioids used.

Response to treatment was either pain free, good relief (only needing simple oral analgesia and/or post treatment pain score 1–3), some relief (reduction in pain by <4 score, and/or discharge with an oral opioid script) or nil (no change in pain score, and/or recorded in notes that there was 'no relief' in pain).

Data were collected by three researchers (RY, FR, AJ) and collated by one investigator (RY). A random 10% check to confirm accuracy of the data collected was performed by a second abstractor (ML).

Data were collected on a Microsoft excel spreadsheet (Microsoft v 16.23).

IRB approval

The project was granted status as a Quality Assurance Project by the Far North Queensland Human Research Ethics Committee.

Results

Over this 3-year period we identified a total of 48 cases who met our case definition.

TABLE 1. Pre-hospital treatment after stung by stinging tree

Method of pain relief	Patients
Methoxyflurane 3 mg	3
Panadeine Forte	1
Paracetamol/ibuprofen	6
Ice to sting	1
Cold water to sting	2
Wax to sting	4
Hot water to sting	1
Torniquet to limb	1
Bicarbonate to sting	1
Ingesting alcohol	1
Mud to sting	1
Urine to sting	1
HCL to sting	1

TABLE 2. *Outcomes with use of HCl*

Pain symptoms	Outcome of treatment		
Nil	2	Nil	3
Mild	0	Some relief	7
Moderate	11	Good relief	8
Severe	16	Pain free	1
		Not recorded	8 (1 patient discharge against medical advice)
		Worsened – dilution error	2

TABLE 3. *Outcomes for those not using HCl*

Pain symptoms	Outcome of treatment		
Nil	0	Nil	1
Mild	4	Some relief	4
Moderate	8	Good relief	2
Severe	7	Pain free	0
		Not recorded	12

Demographic data

There were 36 male patients (75%), with a mean age of 25.9 years and 71% patients were between the ages of 16–35 years. Crystal Cascades, a favoured Cairns swimming hole, was responsible for 20 (42%) of all stings, with 11 different locations identified as the geographical place of the sting. Stings occurred throughout the year with 30 (62.5%) occurring between April and September, and 25 (52%) being visitors to Cairns.

Pre-hospital treatment

The 48 patients received 13 different treatments prior to arrival in the ED, with many victims using more than one technique. Excluding analgesia, there were a variety of other 'first aid' techniques administered (Table 1).

Symptoms and signs

Where recorded, all had immediate pain after contact with the plant (36/36). Most patients (46, 96%)

were stung on their limbs, with a few of these patients also being stung on the trunk (four patients) and face (two patients). One patient was just stung on his face and one patient wandering in the forest naked, was stung on his buttock. The pain was moderate or severe in 42 (87%) patients (Tables 2,3) Where recorded, the majority had local sting site erythema (33/36, 92%), with seven (19%) also having swelling, and one also having local sweating. Only one patient had no local signs.

Treatment

In the ED, the main treatment was for pain relief. Many patients required multiple analgesic agents (Table 4). Opioid analgesia was administered to 60%, with the median oral morphine dose equivalent was 15 mg (range 3–90 mg). For those receiving opioid analgesia who were treated with dilute HCl, the median oral morphine dose equivalent was 22.5 mg, while those not being treated with HCl the median

oral morphine dose equivalent was 7.5 mg. Seventeen patients (35%) had sting site waxing, and six patients (12%) had local anaesthetic gel applied to sting site. Only one case represented, having initially discharged against medical advice.

Patients treated with dilute HCl and effect

As a result of the frequency of presentation, lack of any management guidelines at the Cairns Hospital ED and based on others experience,^{1,9} we developed a treatment guideline utilising dilute HCl as a pain management strategy in patients resistant to initial analgesia. Twenty-nine patients were treated with HCl (Table 2). Nineteen patients did not receive HCl (Table 3). Of the 29 receiving HCl, nine patients reported good relief or complete relief, and only three reported no relief in symptoms. Two patients had a dilution error that resulted in worsening of symptoms. None receiving HCl represented.

Length of stay

Patients had a median length of stay of 164 min (range 29–570 min). Thirty-nine patients (81%) were in the ED for 4 h or less.

A 10% check of the data entered was performed by an investigator (ML) who had not entered the initial data. There was 96% concordance.

Discussion

This is the largest case series of stinging tree exposure in literature to date. This series showed that 48 patients presented to the Cairns Hospital ED in a 3-year period. Patients were stung at 11 locations around Cairns with 42% stung at one location (Crystal Cascades). Where recorded, all had immediate pain on contact with the stinging tree, and 87% described the pain as moderate or severe. Thirteen different therapies were used in the pre-hospital environment, including the use of mud, cold water, urine, ingested alcohol and wax. Opioid analgesia was required in 60% of cases with a median oral morphine

TABLE 4. Analgesia prescribed to patients in ED

Analgesia type	Maximal analgesia type prescribed† (number of patients) (<i>n</i> = 48)	Analgesia prescribed for patients who received HCl‡ (<i>n</i> = 29)	Analgesia prescribed for patients who did not receive HCl‡ (<i>n</i> = 19)
No analgesia	12	3	9
Simple analgesia (NSAID/paracetamol)	7	19	8
Paracetamol/codeine 30 mg	3	2	1
Oral opioids	17	20	6
Parenteral opioids	9	7	2
For those receiving opioid analgesia: median oral morphine dose equivalent	15 mg	22.5 mg	7.5 mg

†To explain, for example, only seven needed simple analgesia to achieve adequate analgesia. Many patients received a variety of different classes of analgesia. ‡Patients in these two groups received different types of analgesia often together (e.g. simple analgesia and oral oxycodone), hence the number is greater than 29 or 19.

equivalent dose of 15 mg. The majority were discharged within 4 h, but in some, pain management proved difficult.

There is very little literature regarding exposure to Australian stinging trees. Maor and Little

published a case report of two patients, managed at Cairns Hospital. Naked, both fell into a stinging tree while intoxicated by methamphetamine and alcohol.⁸ Despite escalating doses of morphine and diazepam they had ongoing severe

pain and agitation and were subsequently intubated to facilitate ongoing management. Their treatment in Cairns included the application of dilute HCl-soaked gauze followed by waxing to the obvious affected areas. They were extubated after 12 h and discharged from the ED after a short stay admission under toxicology, 36 h after presentation. Ongoing pain was described for several months after exposure.⁸

Schmitt *et al.* reported two cases from Asia. One was a 49-year-old man travelling in the Philippines, who had contact with a stinging tree resulting in a painful burning sensation to his hands and paraesthesia to the soles of his feet. He had ongoing paraesthesia to his feet and pruritis to his hands 3 weeks later. The second case described severe pruritis to his ear and arm following contact with a stinging tree in Vietnam. He had complete recovery in 3 days.¹³

Hurley reports receiving a letter from a former soldier who, in 1941, fell into a stinging tree on the Atherton tablelands. The soldier had to be tied to a hospital bed for 3 weeks because of the severe pain. The soldier claimed an officer had shot himself as he could not stand the pain.¹⁴ There are reports of dried specimens CSIRO collected in 1910 still causing pain on contact.¹⁴



Figure 1. Stinging tree warning sign Crystal Cascades Oct 22. This sign is to a bush track running at the side of the Crystal Cascades carpark, well away from the main entrance to Crystal Cascades. There are no warning signs along the main walking path to Crystal Cascades.

An investigation into the chemicals found in the *D. moroides* plant and their effects on six human subjects, as well as various animal tissues, was undertaken by Robertson *et al.* in 1957.⁷ They identified histamine, acetylcholine (ACh) and hydroxytryptamine in the *D. moroides* plants, as well as a heat stable, non-dialyzable substance that the authors reported as the substance that caused the local severe pain. This substance was felt to be the principal cause of the plant's effects. Following dialysis of hair extracts for up to 3 days during which ACh, histamine and hydroxytryptamine were removed, the dermal response to injection of the hairs was the same.⁷ A complex pain response associated with dermal changes, similar to the triple response found with histamine, was found on exposure to the *D. moroides* hairs. The affected area became oedematous and erythematous, piloerection and sweating were seen.⁷ Many of our patients described similar effects, with local sting site erythema (33/36, 92%), seven (19%) having swelling and one patient having local sweating.

Robertson *et al.*⁷ also found antihistamines failed to prevent this response suggesting that in fact it is an alternative substance to histamine that is responsible for this effect. Their paper reported initial intermittent sharp radiating pain was followed by a background diffuse pain with tingling, exacerbated by cold and touch. Referred pain to the opposite side or the thorax and face was also described. The dull pain lasted up to several days, and over several months, allodynia at the site was experienced with pain on exposure to touch or cold.

Gilding and colleagues set out to attempt to identify the neurotoxin responsible for the ongoing and severe pain because of a sting from the stinging tree.¹⁵ From the *D. excelsa*, a stinging tree found in northern NSW, they demonstrated a small, previously unknown pain inducing peptide that potentially activated mouse sensory neurons and delayed inactivation of voltage gated sodium channels. Interestingly, the authors felt the structure and

function of this toxin was similar to toxins found in spiders and cone shells. As the pain is because of an intradermal injection of a toxin, the authors suggested that physical removal of the stinging hairs (e.g. waxing) was unlikely to be of benefit.

As there is no evidence-based literature on how to manage patients exposed to *D. moroides* stings, prevention of the sting is going to be very important. In some of our parks and tourist sights, there are signs (see Figure 1 from Crystal Cascades) warning about the stinging tree. However, this has limited impact, as some of our patients were bush walking away from these signs. In Crystal Cascades, there are no warning signs on the main walking route to the cascades. Many patients were unaware of this painful plant. Better public health awareness campaign is necessary for both locals and visitors, not just to our region but wherever these plants are found, so people can identify the plants and avoid contact.

Anecdotal management advice from the Cape Tribulation Research Centre had suggested the application of dilute HCl to the stinging sites followed by waxing to remove the hairs.⁹ They proposed that the application of dilute HCl to the sting site helps to hydrolyse the pain producing substance and markedly improves symptoms.⁹ Based on this, Cairns Hospital ED developed a guideline for management of stinging tree presentations that included the application of dilute HCl soaks directly to the affected area followed by waxing if patients did not settle with initial treatment (Appendix S1). It is difficult, because of the small numbers and retrospective nature of the present study, to be definitive about the effect of HCl. Where used the majority had moderate or severe pain, and only three had no response to the HCl. Nine patients reporting good or complete relief. Other than two patients who had a dilution error that resulted in a worsening of local symptoms, there were no adverse effects reported with the use of HCl. As a result of the adverse event with HCl use, we have paused the use of the

protocol and are reviewing management options. Further studies are required to better identify the best treatment of this condition.

Limitations

There are certainly limitations to our study. It was a single centre, retrospective, chart review and we had incomplete data in several patients. The diagnosis of a stinging tree sting was clinical, and we could not be certain that all cases were of people stung by *D. moroides*. Our initial search criteria may have missed cases.

Conclusion

The present study suggests that the sting by the stinging tree in the Cairns region results in severe and immediate pain and resulted in 48 patients presenting in 3 years. There is no clear first aid or definitive treatment. Further work is required to ascertain the best first aid and definitive treatment, including a formal trial of the use of dilute HCl.

Author contributions

ML – Conception or design of the work; RY, FR and AJ – Data collection; ML and RY – Data analysis and interpretation; RY and ML – Drafting the article; RY and ML – Critical revision of the article; RY, AJ, FR and ML – Final approval of the version to be published.

Competing interests

ML is a section editor for *Emergency Medicine Australasia*.

Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request, and approval from the ethics committee.

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Supporting information

Additional supporting information may be found in the online version of this article at the publisher's web site:

Appendix S1. Cairns Hospital ED stinging tree management protocol.