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## Short report

# Outbreak of ciguatera poisoning in a commercial vessel: lessons learnt and prospects of early diagnosis, management, and prophylaxis

Svetlana Krasnova, Nicolas Smoll, Steve Carter, Mark McManus, Dilip Kumar, Gulam Khandaker

## Abstract

An outbreak of food poisoning of unknown origin was notified to Central Queensland Public Health Unit on 9 December 2021. The bulk carrier sailing from Higashiharima, Japan to Gladstone, Australia reported an incident of sudden illness, with 19 out of 20 sailors on board reporting a combination of gastrointestinal and neurological symptoms. Central Queensland Public Health Unit started the outbreak investigation as per Queensland Health public health management guidelines. All 20 of the sailors consumed a self-caught barracuda and squid, prepared by the ship's cook, the day before.

Unconsumed samples of the fish and squid were sent for testing. The affected sailors were triaged on arrival and were provided with medical care as required. The barracuda sample contained ciguatoxins (CTXs; P-CTX-1, P-CTX-2, P-CTX-3) with a total count of 3.40 ug/kg confirming the diagnosis. We propose the usage of the combination of gastrointestinal symptoms and paraesthesia in the light of a recent intoxication event for early detection of ciguatera poisoning (CP) in the eastern seaboard of Australia.

Keywords: ciguatera poisoning; outbreak; eastern seaboard of Australia; public health

## Background and methods

On 9 December 2021, Central Queensland Public Health Unit (CQPHU) received notification from the State Health Emergency Coordination Centre of a possible food poisoning outbreak of unknown origin on a commercial vessel anchored at Gladstone Port. The vessel was a bulk carrier, sailing under the flag of Liberia, which had arrived at Gladstone Port on 23 November 2021 from Higashiharima, Japan. CQPHU liaised with Maritime Safety Queensland Branch, Queensland Ambulance Service and Emergency Department of Gladstone Hospital regarding the possible mass casualty event. The ongoing coronavirus disease 2019 (COVID-19) pandemic and border closures contributed to the additional challenges of getting the patients onshore, maintaining heightened infection control and meeting personal protective equipment

(PPE) requirements. An emergency department physician was deployed to the Gladstone Port to undertake a rapid assessment and triage of the disembarked crew members prior to transport to the hospital. Most of the crew members who fitted the definition of a probable case were complaining of sudden onset of nausea, vomiting, diarrhoea, abdominal pain, fatigue, muscle pains and aches and a variety of neurological symptoms including paraesthesia, ataxia, and a metallic taste in the mouth. The crew members were males from the Philippines, 26–54 years old with a mean age of 40 years, all of whom had ingested the self-caught barracuda and squid, prepared by the ship's cook, on 8th December.

## Outbreak description

The CQPHU coordinated the response to organise the medical assessment of the affected

sailors and the eventual transportation to the Gladstone Hospital Emergency Department if required.

The majority of the crew members were symptomatic, with an attack rate of 95% (n = 19/20). The most common symptoms were gastrointestinal disorders, including diarrhoea (85%; n = 17/20), abdominal pain (70%; n = 14/20) and vomiting (60%; n = 12/20), which responding to symptomatic medical management. Myalgia was experienced by 70% of the crew (n = 14/20) and 40% (n = 8/20) complained of paraesthesia (Table 1). The majority of cases (75%; n=15/20) were mild and did not require emergency department review or hospitalisation. A quarter of those sailors who ate the meal (25%; n = 5/20) required inpatient medical management, at times due to concerns around significant past medical history (10%; n = 2/20). One patient with a background of diabetes mellitus type II developed dehydration which precipitated electrolyte and blood glucose level derangement, in addition to the ciguatera-specific symptom of hypotonia. Another sailor had an underlying acute kidney injury resulting from dehydration, which led to three days' admission for intravenous therapy and a subsequent full recovery.

## Laboratory, trace back and environmental investigations and Public Health response

CQPHU worked with local teams to obtain samples of the mostly eaten *Sphyraena jello* (pickhandle barracuda) and *Uroteuthis* spp. (Loligo squid) from the bulk carrier. No samples of the symptomatic individuals' stool or vomit masses were available. Samples were transferred to Queensland Health Forensic and Scientific Services for analysis. The samples were analysed by inhouse method 31699 ('Determination of Pacific Ciguatoxins in fish'). Initially, the fish fillet was minced and homogenised. The sample was then extracted with methanol. The extracts were cleaned up using solvent extraction and solid phase extraction cartridges. Analytes were reconstituted in methanol and submitted to high pressure liquid chromatography – tandem mass spectrometry (HPLC-MS/MS) [Sciex 6500 Qtrap] for identification and quantification.<sup>1-3</sup> This HPLC-MS/MS method, utilising a rapid methanol extraction and clean-up, is reliable and reproducible, and has reported as the preferred method of testing in other ciguatera poisoning (CP) outbreaks in Australia.<sup>1,4</sup> Ciguatoxins (CTXs) tested were P-CTX-1,

**Table 1: Number and proportion of symptoms reported by cases in an outbreak of ciguatera fish poisoning, December 2021**

Symptoms	Cases reporting symptoms		
	Number N = 20	Percentage	
Gastrointestinal symptoms	Diarrhoea	17	85
	Vomiting	12	60
	Abdominal pain	14	70
Neurological symptoms	Paraesthesia	8	40
	Metallic taste in the mouth	1	5
Other symptoms	Myalgia	14	70
	Fever	0	0
Late symptoms	Cardiac complications	0	0
Comorbidities	Dysuria	0	0
	Underlying medical condition	2	10
Hospital admission		5	25
Complications		1	5

P-CTX-2 and P-CTX-3, with a lower reference range (limit of reporting) of 0.05 µg/kg; that is, any value exceeding 0.05 µg/kg is considered to be abnormal. No CTXs were detected in the squid sample. The barracuda sample contained P-CTX-1 (2.28 µg/kg), P-CTX-2 (0.87 µg/kg) and P-CTX-3 (0.26 µg/kg), equating to a total CTX content of 3.40 µg/kg and confirming the barracuda as the source of CP.

## Discussion

This outbreak of CP on a ship, affecting 19 persons, provided key insights useful for the early detection of ciguatera outbreaks. We suggest that the combination of gastrointestinal symptoms and paraesthesia in at least 40% of the affected consumers of ocean fish could be used to classify a foodborne outbreak in the eastern seaboard of Australia as highly likely due to CP. A similar proportion has been obtained during a ciguatera outbreak investigation in Puerto Rico, involving 80 cases, where gastrointestinal involvement was reported by 69–83% of cases and paraesthesia of different locations was noted by 36–54% of cases.<sup>5</sup> However, a systematic review of CP cases in Caribbean and Pacific regions has identified several studies which report a much larger proportion of paraesthesia (67–100%) versus gastrointestinal symptoms (50–81%).<sup>6</sup> According to multiple observations reflected in the current literature, there is a correlation between the clinical picture of CP and the area where the contaminated fish has been caught. For example, Pacific region CP tends to trigger more neurological disorders, and Caribbean region CP leads to a greater preponderance of gastrointestinal symptoms. However, we observed a different picture in our series.<sup>7</sup> A recent ciguatera outbreak in Victoria, resulted from consumption of contaminated fish caught in Queensland waters, demonstrated a high prevalence of paraesthesia in 77–87% of cases and a slightly low percentage (67%) of gastrointestinal symptoms.<sup>8</sup> Three more outbreaks of CP have occurred in New South Wales in 2014–2015; there has been no description of the symptoms breakdown among these cases.<sup>4</sup>

CP is a global problem which has significant social and economic impact. Around 50,000 persons, residing in tropical and subtropical latitudes, are affected by CP annually.<sup>9</sup> Many sufferers have debilitating gastrointestinal, cardiological and neurological disturbances, and must avoid fish consumption after the acute episode of poisoning, thus limiting their access to a main source of protein.<sup>10</sup> The CTX-affected fish species mostly belong to the group of high-valued commercial species; therefore, the necessary implementation of monitoring programmes and fisheries restrictions adds an additional complication to the local and global fish trade.<sup>9</sup>

Unfortunately, the crew of the commercial vessel had no access to testing facilities to check potential food contamination with CTX. The previously available commercial market Cigua-Check<sup>®</sup> test kits have proven to be unreliable and very operator-dependant, so equipping ships with point-of-care devices has not been practical.<sup>11</sup> Upon assessing the uniformity of conclusions by multiple readers examining identical Cigua-Check<sup>®</sup> test strips, only 11.9% of 121 truly positive samples were uniformly agreed to be positive by the assessors, and only 26.9% of the 67 negative samples were uniformly identified as true negatives.<sup>11</sup> There are some promising advances in the development of portable smartphone-controlled amperometric or electrochemical immunosensors in the detection of CTX aboard ships; however, the complicated multi-step sample extraction and purification process is a limiting factor.<sup>12–14</sup> The Australian Seafood Handling Guidelines determine ciguatera high-risk areas and species to minimise the chance of catching seafood contaminated with CTX.<sup>15</sup> Given the route of the bulk carrier sailing from Higashiharima, Japan to Gladstone, Australia, it could potentially pass through the Marshall Islands, classified as a prohibited fish supply region by the Seafood Handling Guidelines.<sup>15</sup>

The outbreak of CP on the bulk carrier at the Gladstone anchorage has highlighted the importance of this disease in the Central Queensland region. According to our research, the combination of gastrointestinal symptoms, paraesthesia and a recent intoxication event is a feature triad suggestive of a high likelihood of CP. In the absence of etiological treatment, effort should be directed towards health promotion initiatives including raising awareness in the general public, marine personnel, and physicians. A second direction of work is establishing food safety policies imposing limits on species of fish and fishing regions. Interactive maps advising of the risk of ciguatera can guide fishing locations.

## Ethics approval

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