

# TETRODOTOXIN POISONING FOLLOWING INGESTION OF THE TOXIC EGGS OF THE HORSESHOE CRAB *CARCINOSCORPIUS ROTUNDICAUDA*, A CASE SERIES FROM 1994 THROUGH 2006

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**Abstract.** Between 1994 and 2006, a total of 280 cases of varying degrees of tetrodotoxin poisoning following ingestion of the toxic eggs of the horseshoe crab, *Carcinoscorpius rotundicauda*, were admitted to the medical service of Chon Buri Hospital. The severity of the poisoning was classified into four stages based on clinical signs and symptoms of human tetrodotoxination. Of 245 available medical records; 100 were in stage 1, 74 were in stage 2, 3 were in stage 3 and 68 were in stage 4. The frequencies of symptoms and signs included the following : circumoral and lingual numbness (98%), hands and feet numbness (94.7%), weakness (59.6%), dizziness and vertigo (54.3%), nausea and vomiting (52.6%), transient hypertension (39.6%), respiratory paralysis (27.7%), fixed dilated pupils (14.7%), ophthalmoplegia (12.2%), blood pressure lower than 90/60 mmHg (5.7%), and polyuria (0.4%). All patients received symptomatic and supportive treatment. Endotracheal intubation and mechanical ventilation were considered when paralysis was progressing rapidly. The results of treatment are as follows : 239 patients (97.5%) showed complete recovery, 5 patients (2%) died, and 1 patient (0.4%) suffered anoxic brain damage. Horseshoe crab poisoning occurs both sporadically and epidemically in Chon Buri. Seasonal variation in the number of cases of poisoning was observed with a peak from December through March.

## INTRODUCTION

Four species of the horseshoe crab exist in the world. Two of these inhabit the Gulf of Thailand : the triangle-tailed horseshoe crab (*Tachypleus gigas*) and the round-tailed horseshoe crab (*Carcinoscorpius rotundicauda*). Various dishes made from the eggs of horseshoe crabs are quite popular among Thai people.

Before 1994, there were only six cases of horseshoe crab poisoning reported in Thailand (Trishnanada *et al*, 1966). Since 1994, horseshoe crab poisoning has occurred both spo-

radically and epidemically in Chon Buri which is located on the eastern coast of Thailand. The causative species is *C. rotundicauda*. Tetrodotoxin (TTX) is a major toxin in the eggs (Kungsuwan *et al*, 1987, 1988; Kanchanapongkul and Kittayapooisitpot, 1995; Kanchanapongkul *et al*, 1996).

This article reports a number of incidents of horseshoe crab poisoning occurring during the years 1994-2006.

## MATERIALS AND METHODS

During the period January 1994 to December 2006, a total of 280 cases of TTX poisoning following ingestion of the toxic eggs of the horseshoe crab *C. rotundicauda*, were admitted to the medical service of Chon Buri Hospital. There were 245 available medical records.

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Table 1  
Clinical staging of tetrodotoxin poisoning.

Stage of poisoning	Symptoms and signs
Stage 1	Perioral and lingual numbness or paresthesia, nausea, vomiting
Stage 2	Numbness progresses markedly, motor paralysis of extremities
Stage 3	Progressive motor paralysis, bulbar muscle paralysis. Patient is conscious.
Stage 4	Respiratory failure, hypoxia, unconsciousness and hypotension may occur, fixed and dilated pupils

Table 2  
Outcome of patients according to their stage of poisoning.

Stage	No. of cases	Outcome		
		Complete recovery	Brain anoxia	Death
1	100	100	0	0
2	74	74	0	0
3	3	3	0	0
4	68	62	1	5

Table 3  
Frequency of symptoms and signs among 245 patients after consumption of the toxic eggs of *C. rotundicauda*.

Symptoms and signs	N (%)
Circumoral, lingual numbness	240 (98)
Hands and feet numbness	232 (94.7)
Weakness	146 (59.6)
Dizziness, vertigo	133 (54.3)
Nausea, vomiting	129 (52.6)
Transient hypertension	97 (39.6)
Respiratory paralysis	68 (27.7)
Fixed dilated pupils	36 (14.7)
Ophthalmoplegia	30 (12.2)
Hypotension (BP < 90/60 mmHg)	14 (5.7)
Polyuria	1 (0.4)

The severity of the poisoning was classified into four stages based on symptoms and signs of human tetrodotoxification (Table 1).

## RESULTS

The number of cases of horseshoe crab poisoning per year and per month are shown in Figs 1 and 2, respectively. Of 245 patients,

181 were males and 64 were females. Clinical staging and results of treatment are shown in Table 2. Frequencies of certain symptoms and signs are shown in Table 3.

The most common presenting complaint in these patients was circumoral and/or lingual numbness. Weakness, dizziness, vertigo, nausea and vomiting were common complaints. Sixty-one patients developed total paralysis with respiratory paralysis requiring ventilatory support. Fixed and dilated pupils and ophthalmoplegia usually developed in totally paralyzed patients with or without altered consciousness. Marked hypotension developed in fourteen patients.

All patients were managed with symptomatic and supportive treatment. Most of the patients with stage 1 or stage 2 illness were discharged within 24-48 hours. All patients with stage 4 illness were intubated and ventilated, some of them were transferred to the medical intensive care unit. Most of them were taken off the respirator 12-24 hours later. In patients with severe poisoning, respiratory support was needed for a period of 48-72 hours. Severe cases with marked hypotension

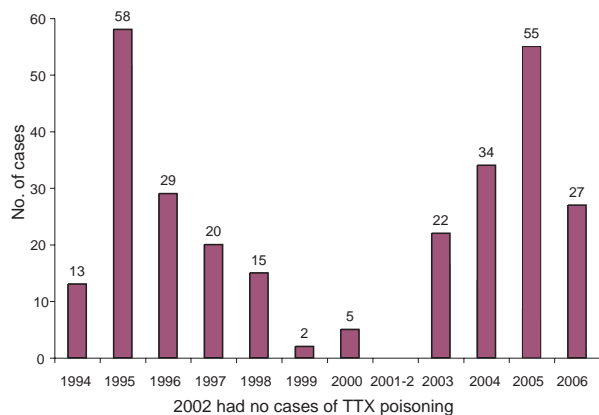


Fig 1—Number of cases of TTX poisoning following ingestion of the toxic eggs of *C. rotundicauda*, January 1988 through December 2006.

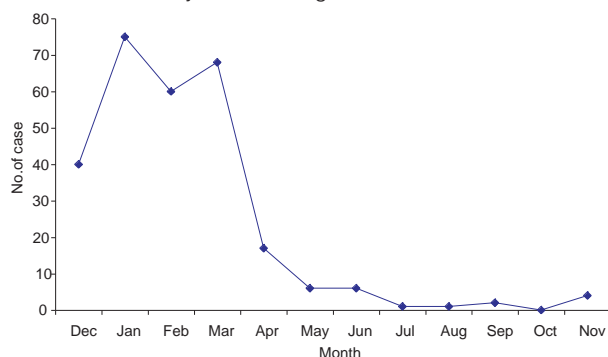


Fig 2—Number of TTX poisoning cases following ingestion of the toxic eggs of *C. rotundicauda*, by month of admission to the hospital.

were treated with intravenous dopamine or adrenaline.

Two hundred thirty-nine patients had complete recovery without any sequelae. Four patients died from hypotension and cardiovascular collapse. One patient who suffered anoxic brain damage died from hospital-acquired pneumonia. One patient suffered anoxic brain damage (Table 4).

## DISCUSSION

TTX poisoning, following ingestion of the toxic eggs of *C. rotundicauda*, is frequently seen in Chon Buri. To the best of the author's knowledge, this is the largest number of horseshoe crab poisoning cases reported in the

medical literature. Seasonal variation in the number of cases of horseshoe crab poisoning was observed with a peak from December through March.

TTX is a water soluble heterocyclic guanidine. TTX abolishes propagated action potentials through its selective blockade of voltage-gated neuronal sodium channels (Catterall, 1980). The clinical effects of TTX poisoning develop rapidly and severity depends on the amount of toxin ingested. Early symptoms are perioral, lingual and distal limb numbness and paresthesia. In cases of mild poisoning, only sensory features develop and are associated with nausea and vomiting. Patients with moderately severe poisoning develop limb and bulbar muscle weakness. Severe poisoning causes generalized flaccid paralysis, respiratory failure, and fixed and dilated pupils with or without alteration of consciousness. Severe and life-threatening TTX poisoning is characterized by respiratory failure, hypotension, cardiovascular collapse, and alteration of consciousness.

The diagnosis of TTX poisoning is clinical. Analysis of the patient's urine or serum for TTX confirms the diagnosis. High performance liquid chromatography allows simple quantification of TTX in urine and serum. Cases where urine and serum were tested for TTX indicate that serum concentrations of TTX fall rapidly and may be undetectable after 12-24 hours. However, TTX can be detected in urine for up to five days after ingestion and evaluation of TTX in a 24-hour urine collection immediately after poisoning is likely to be the most sensitive test (Oda *et al*, 1989; O'Leary *et al*, 2004; Isbister and Kiernan, 2005).

Neurophysiological investigations of patients with TTX poisoning, following ingestion of the puffer fish, documented reduced amplitudes of compound motor and sensory potentials, slowing of conduction velocities, and lengthening of distal motor latencies and F-wave latencies (Oda *et al*, 1989; Kiernan *et al*, 2005).

Table 4

Summary of five patients who died and one patient who suffered anoxic brain damage.

Patient No.	Age(yr)/Sex	Duration in the hospital	Result	Cause of death
1	67/Female	35 hours	D	Cardiovascular collapse
2	17/Female	8 hours	D	Cardiovascular collapse
3	40/Female	76 hours	D	Cardiovascular collapse
4	85/Male	38 hours	D	Cardiovascular collapse
5	37/Male	12 days	D	Brain anoxia, pneumonia
6	49/Male	32 days	Brain anoxia	-

Prevention of horseshoe crab poisoning remains a problem partly because of the following inaccurate folklore: 1) differentiation can be made between poisonous and edible horseshoe crabs, 2) a horseshoe crab that was previously safe to eat is always non-toxic, 3) heating can destroy the toxin, 4) non-toxic eggs burst on heating.

This report highlights the seriousness of TTX poisoning and its potential to be life threatening. Physicians should have sufficient knowledge regarding the clinical manifestations, complications and management of TTX poisoning. People should be made aware of the potential risk of eating the eggs of *C. rotundicauda*, about the warning symptoms and signs of poisoning, and when to seek medical help. All but the mildest cases should be admitted to the hospital for close observation. After 24 hours it is unlikely that life-threatening conditions will occur in patients who have not already developed severe effects.

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