Shellfish Poisoning

Includes Paralytic and Amnesic Shellfish Poisoning

Case Definition

**Confirmed Case**
Clinical illness\(^1\) with:
- Detection of saxitoxin (toxin associated with paralytic shellfish poisoning [PSP]) or domoic acid (toxin associated with amnesic shellfish poisoning [ASP]) in epidemiologically-related, ingested shellfish\(^2\).

**OR**
- Detection of high levels of dinoflagellates associated with shellfish poisoning in water from which epidemiologically-related shellfish\(^2\) were gathered.

**Probable Case**
Clinical illness\(^1\) after recent consumption of shellfish\(^2\).

\(^1\) PSP: Clinical illness is characterized by neurological symptoms such as paresthesia and/or paralysis involving the mouth and extremities, which may be accompanied by gastrointestinal symptoms (nausea, vomiting, diarrhea, and abdominal pain) within 12 hours of ingestion of contaminated shellfish.

ASP: Clinical illness is characterized by rapid onset of gastrointestinal symptoms such as nausea, vomiting, abdominal cramps and diarrhea within 30 minutes to six hours of ingestion of contaminated shellfish, followed in some cases by neurological manifestations such as headache, confusion, loss of memory, seizures and coma.

\(^2\) The shellfish most associated with saxitoxin (PSP) include bivalve molluscs (e.g., oysters, clams, mussels), non-bivalve shellfish (e.g., whelks, moon snails and dogwinkles) or tomalley of crustaceans (e.g., crabs, lobster).\(^1\) The shellfish most associated with domoic acid (ASP) include mussels (blue and red horse), clams (hard and soft shell), oysters, scallops, lobster, anchovies or sardines.\(^2\)
Reporting Requirements

1. Physicians
Physicians shall notify the Medical Officer of Health (MOH) (or designate) of all confirmed and probable cases by the fastest means possible (FMP) i.e., direct voice communication.

2. Laboratories
All laboratories, including regional laboratories and the Provincial Laboratory for Public Health (PLPH), shall report all positive laboratory results by FMP to the:
- Chief Medical Officer of Health (CMOH) (or designate),
- MOH (or designate) and
- Attending/ordering physician.

3. Alberta Health Services
- The MOH (or designate) shall notify (as detailed in the Notice dated March 22, 2011) the CMOH (or designate) of all confirmed and probable cases by FMP.
- The MOH (or designate) shall report in the prescribed form (as detailed in the Notice dated March 22, 2011) using the preliminary Notifiable Disease Report (NDR) of all confirmed and probable cases to the CMOH (or designate) within seven days (one week) of notification and the final NDR (amendments) within two weeks of notification.
- For out-of-zone reports, the MOH (or designate) first notified shall notify the MOH (or designate) where the client resides by FMP and immediately fax a copy of the positive laboratory report.
- For out-of-province and out-of-country reports, the following information should be forwarded to the CMOH (or designate) by FMP, including:
  - name,
  - date of birth,
  - out of province health care number,
  - out of province address and phone number,
  - attending physician (locally and out-of-province) and
  - positive laboratory report (faxed).

4. Additional Reporting Requirements
- Under the Canadian Shellfish Sanitation Program (CSSP), shellfish samples are taken directly from shellfish growing areas and are regularly analyzed for ASP, DSP (Diarrhetic Shellfish Poisoning) and PSP toxins. Hundreds of sites in Atlantic Canada, Quebec and British Columbia are regularly tested for these toxins.

Note: Shellfish poisoning, like botulism, is a potentially lethal intoxication and its reporting leads to both public health intervention to limit further consumption of associated bivalves and review of fisheries regulations and postings.(3)


**Etiology**

PSP: In North America, paralytic shellfish poisoning (PSP) is caused by the presence of the marine biotoxins saxitoxins (SXT’s) and gonyautoxins (GTX’s) produced mainly by *Alexandrium* (previously called *Gonyaulax*) species and other dinoflagellates (oceanic phytoplankton).(1;4) There are an extensive number of PSP-type marine biotoxins worldwide, the most toxic and representative being the saxitoxin.(5)

ASP: Amnesic shellfish poisoning (ASP) is caused by the presence of the marine biotoxin domoic acid (DOM) that is produced by different species of marine organisms such as the diatoms (microscopic algae) *Pseudo-nitzschia* multiseries and *P. pseudodelicatissima* found on the east coast of Canada and *Pseudo-nitzschia* species (including *P. australis*) on the west coast.(2)

Shellfish accumulate the toxins by feeding on the contaminated organisms or by direct filtration of the plankton.(6)

**Presentation**

PSP: The relative potency of the toxins is greater for PSP in comparison with ASP. PSP is a potent neurotoxin that can pose a severe health threat. The intensity and progression of the symptoms are dependent on the type and amount of the toxin ingested and the level of concentration of the toxin in the shellfish. Symptoms of PSP begin with tingling sensation or numbness around the lips within 5 to 30 minutes of ingestion, gradually spreading to the face and neck. Other symptoms may include prickly sensation in the fingertips/toes, headache, dizziness or a “floating” sensation. Gastrointestinal symptoms such as nausea, vomiting and abdominal pain are less common. Symptoms usually resolve within a few hours to a few days.(1;7)

In severe cases, incoherent speech, a prickly sensation in the arms and legs, stiffness and non-coordination of limbs, weakness and a rapid pulse may occur. In extreme cases, the respiratory muscles may become paralyzed leading to respiratory arrest and death within 2 to 12 hours after consumption. Victims who survive for 24 to 48 hours usually recover without sequelae.(4;7)

ASP: The clinical signs and symptoms of ASP can involve multiple organ systems including the gastrointestinal tract, the central nervous system and the cardiovascular system. Acute gastrointestinal symptoms (e.g., nausea, vomiting, abdominal cramps and/or diarrhea) usually occur within 30 minutes to 6 hours after ingestion of contaminated shellfish, but may occur within 24 hours. In more severe cases, neurological symptoms such as headache, hyporeflexia, hemiparesis, opthalmoplegia, seizures, coma and loss of short-term memory, may follow within 48 hours. In those with neurologic sequelae, the memory deficits may be permanent. Higher cortical function and preservation of intellect distinguishes this disease from Alzheimer’s disease. Other symptoms may include unstable blood pressure and cardiac arrhythmias.(8-10)

Generally, the acute symptoms of ASP are typically mild in comparison to PSP and the individual usually recovers within a few days.

**Diagnosis**

A diagnosis of PSP or ASP should be considered based on observation of clinical symptoms with recent consumption of shellfish. Confirmation of the diagnosis can be made by detection of the toxin in samples of stomach contents, water or food.(11)
Epidemiology

Reservoir
PSP: The main reservoir is bivalve shellfish (shellfish with two hinged shells) such as clams, oysters, mussels, scallops and cockles but may also occur in non-bivalve shellfish such as whelks, moon snails and dogwinkles. These shellfish are filter feeders that accumulate high levels of marine biotoxins produced by microscopic algae during massive algal blooms or “red tides”. The toxin may also be present in the absence of recognizable algal blooms. The shellfish can remain toxic for a few weeks after the last exposure to the toxin, with some species persistently toxic. For example, butter clams and scallops can retain PSP toxins for a long period of time, sometimes more than a year. In addition, certain types of shellfish accumulate more toxin than others. Mussels have nerves that are insensitive to PSP toxins in contrast to oysters and therefore retain higher levels of toxin. (12)

The tomalley or hepatopancreas (the soft green substance inside the body cavity) of crustaceans such as crabs and lobster which have fed on contaminated bivalve shellfish may also contain PSP toxins. The majority of the toxin within the shellfish is normally found within the digestive gland. Other shellfish, such as shrimp and prawns are not affected. (7;13)

ASP: The main reservoir is the blue mussel, but it can also be found in other shellfish and seafood that feed on Pseudo-nitzschia such as crabs, oysters, clams, scallops, lobster, anchovies and sardines. (2; 8) The toxin is rapidly cleared from most shellfish however some shellfish such as red (horse) mussels and Atlantic scallop may accumulate the toxin over a long period of time. (2;14)

Transmission
The toxins are transmitted to humans when raw or cooked, contaminated shellfish are consumed. There is evidence that domoic acid associated with ASP crosses the placenta, but no cases of neonatal ASP have been identified. (8)

Incubation Period
PSP: Symptoms may occur within a few minutes and up to 10 hours after ingestion. (3)
ASP: Symptoms usually occur 30 minutes to 6 hours after ingestion. (2)

Period of Communicability
None. PSP and ASP are not transmitted from person to person.

Host Susceptibility
PSP: There are varying degrees of susceptibility to PSP. Some individuals have a natural tolerance to large amounts of the toxin and others have demonstrated an acquired tolerance. Children are more susceptible. (15) Alcohol consumption may have a protective effect against the toxins by having a diuretic effect. (16)

ASP: Older individuals (greater than 60 years) especially males, may be at increased risk for permanent cognitive dysfunction. Those with more severe neurologic illness under the age of 65, typically have co-existing illnesses such as diabetes, chronic renal disease and hypertension with a history of transient ischemic attacks. (17) Animal studies suggest that exposure to low levels of domoic acid during the neonatal period is associated with lasting cognitive deficits and behavioural problems in adults. (8)
Occurrence

General
Incidence of shellfish poisoning and severity of toxicity are on the rise. It has been hypothesized that this is linked to global warming and human impact on the environment. Nutrient enrichment from agricultural runoff may play a role in the frequency and severity of algal blooms in adjacent marine waters.(18)

PSP: Paralytic shellfish poisoning has occurred worldwide and is common in shellfish harvested from waters above 30°N and below 30°S. The most common areas are the northwest and northeast United States, southern Chile, the North Sea and Japan.(9)

Paralytic shellfish poisoning is uncommon in North America with small clusters occurring sporadically mainly in coastal locations. The overall mortality is estimated at 10% and is related to how quickly adequate ventilation can be established.(15)

ASP: Amnesic shellfish poisoning has occurred worldwide and is found in sea waters of both warm and cold climates.(6) It is mainly found in Eastern Canada, and north-eastern and western United States, especially the coastal waters of Washington state and Oregon.(9)

Canada
PSP: Saxitoxins are the dominant toxin found in shellfish species located in British Columbia and Gaspé region of Quebec. Gonyautoxins are more prevalent in shellfish species in the Bay of Fundy region of the east coast.(1) Shellfish can have high levels of marine toxins during any given month depending on environmental conditions(19) however, algal blooms of dinoflagellates usually occur during the warmer months of June to October.(20)

The earliest reported case of PSP in Canada dates back to 1793 from shellfish harvested from what is now known as Poison Cove in British Columbia.(21) Cases of PSP are likely rare in Canada but also may be under reported as it was only been made nationally notifiable in 2008.

The Canadian Food Inspection Agency (CFIA) reported PSP in the tomalley of a small number of lobsters during the 2008 late fall and early winter lobster harvest season. There have not been any confirmed cases of PSP illness in Canada from consumption of lobster or crab tomalley.(7)

ASP: This marine toxin disease was first reported from Canada and is mainly associated with Eastern coastal waters in PEI and the Bay of Fundy. It has also been detected on the Canadian west coast. The greatest contamination of PEI shellfish has occurred in November and December.(2)

A severe ASP outbreak in 1987 in Prince Edward Island linked to consumption of cultivated mussels resulted in 145 confirmed or probable cases, 26 hospitalizations and four deaths.(22) Since then, monitoring programs initiated to detect ASP have been successful in preventing additional human cases. However, domoic acid intoxication has been documented in wild animals.(8)

Alberta
This is a newly notifiable disease in Alberta. There is no epidemiological data available at this time.
Key Investigation

Single Case/Household Cluster

- Determine the possible source of the infection taking into consideration the incubation period and reservoir. Assessment may include:
  - determining history of travel,
  - taking a food history for shellfish consumption,
  - determining where the case purchased or consumed shellfish (e.g., restaurant, fish vendor, grocery store), and/or
  - if the case harvested the shellfish, determine the area where it was dug.

- Identify epidemiologically linked contacts. Assess for similar symptoms in individuals who consumed the source (if identified).

- Suspected contaminated shellfish may be held to prevent consumption and sent to CFIA for testing.

Control

Management of a Case

- Individuals who feel ill (as per the above clinical presentation) after eating bivalve shellfish should seek immediate medical attention.(19)

- Individuals with serious illness should be hospitalized and placed under respiratory care.(7)

Treatment of a Case

PSP: There is no known antidote. Antibodies to saxitoxin have been tested and developed in animals models, but are not yet available for treatment in humans.(23) At the first sign of illness, Health Canada recommends inducing vomiting, taking a laxative and drinking water with baking soda, and then seeking medical care as soon as possible.(1) The World Health Organization (WHO) suggests that diuretics may be of benefit as the toxin is cleared from the body via the urine.(11)

ASP: Treatment of ASP is symptomatic and supportive. Seizure activity has been controlled with intravenous diazepam and phenobarbital, but dilantin has shown to be ineffective in controlling seizures in some cases.(24)

Management of Contacts

- Although not transmissible from person to person, contact follow-up is recommended for those who may have shared the food. They should be instructed in disease symptoms, when to seek medical attention, incubation period and preventive measures.

- Symptomatic contacts should be instructed to seek immediate medical attention.

Preventive Measures

- In Canada, under the Canadian Shellfish Sanitation Program (CSSP), molluscan bivalves in all harvest areas are regularly tested for the presence of saxitoxin and other shellfish toxins.

- Consumers should exercise caution when purchasing or harvesting bivalve shellfish.
  - Shellfish should only be purchased from a reputable retail store or restaurant as the shellfish sold in these establishments come from a federally inspected shellfish processing plant.(18)
  - Contact the nearest Fisheries and Oceans Canada (DFO) office (listed in the blue pages of telephone directories) or refer to the harvest site contact information on the Canadian Shellfish Sanitation Program (CSSP) website to determine which areas are "open" (i.e., considered safe for bivalve harvesting). When an area is officially “closed”, it is illegal to...
harvest bivalve shellfish in that area for any purpose, unless a special scientific licence is issued.

- Bivalve shellfish are highly perishable and should be refrigerated or frozen until they are ready to be eaten. Paralytic/amnesic shellfish poisoning is heat stable and water soluble and is not destroyed by cooking or freezing.\textsuperscript{(25)} The toxins are not detectable by sight or smell.\textsuperscript{(9)}

- Health Canada advises that adults limit their consumption of lobster tomalley to no more than the amount from one cooked lobster per day and does not recommend consumption by children.\textsuperscript{(7)} Refer to the Health Canada Lobster Consumption Advisory.

- Refer to Shellfish Advice for Consumers, Bivalve Shellfish Safety: Restaurant Operator Advice and Shellfish Safety: Advice for Harvesters for additional safety considerations regarding purchase, storage, preparation, etc.

- As PSP can occur in other countries, tourists should be cautious when consuming shellfish abroad.\textsuperscript{(7)}
References


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