Gathering Safe Shellfish in Washington: Avoiding Paralytic Shellfish Poisoning

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Paralytic Shellfish Poisoning

Paralytic shellfish poisoning (PSP) is a serious illness caused by eating shellfish that have consumed large amounts of a poison-producing microscopic organism known as Alexandrium catenella (formerly called Gonyaulax catenella or Protogonyaulax catenella).

The A. catenella toxins are extremely potent nerve poisons. In fact, as little as one milligram (0.000035 ounce) can be enough to kill an adult.

The poison acts very rapidly, and no antidote has as yet been discovered. The poisons themselves, as well as the illness they cause, are referred to as PSP.

Symptoms

Tingling of the lips and tongue, which may begin within minutes or hours of eating shellfish, is an early symptom of PSP. Depending upon the amount of toxin ingested with the shellfish, the symptoms may progress to tingling of the fingers and toes, the loss of control of arms and legs, and finally difficulty in breathing. Some people who have survived PSP report a sense of floating, while other PSP patients became nauseated. If enough of the poison is consumed, death from paralysis of the breathing mechanism can result in as little as two hours. Approximately 15 percent of the reported cases of PSP have resulted in death. There is no known antidote for PSP toxins.

Allergic reactions and gastrointestinal problems can also be experienced from eating shellfish and should be carefully distinguished from the PSP symptoms described above.

Treatment

It is essential to begin treating PSP immediately-as soon as the lips or tongue begin to tingle. The toxins can take effect rapidly. Induce vomiting by using ipecac or some other means and give a brisk laxative to remove the toxic shellfish from the digestive tract. Get the patient to a doctor at once. If this is not possible, prepare to administer artificial respiration for many hours.

Alexandrium-Poison Producer

A brief description of Alexandrium catenella, the poison-producing organism, will help to explain the seasonal occurrence of shellfish containing PSP toxins and the differences in timing of toxicity in different shellfish. Alexandrium catenella is a microscopic singlecelled type of plankton. Plankton are plants and animals that are carried along by the currents.

Alexandrium catenella belongs to a group called dinoflagellates, which have both plant and animal characteristics, can manufacture their own food, and can swim. Each cell of A. catenella can live independently, but during periods of rapid growth and division, the cells remain attached to each other in a chain-hence the name catenella or "little chain." Each cell is equipped with two tiny whips used in swimming. At times, some of the swimming cells drop their whips and form non-swimming, heavy-walled resting cells or cysts. These settle to the bottom and can lie dormant in the bottom sediment through low winter temperatures. Many of the cysts are eaten by animals, including bivalve shellfish, or become buried. Some germinate when environmental conditions are favorable, giving rise to another population of swimming cells.

PSP Seasons

In general, shellfish are more likely to become poisonous in late spring, summer, and fall rather than in winter. However, you should be aware that some species-particularly butter clams and scallops-tend to be toxic for longer periods of time, even throughout the year in some areas. In the spring, longer days and warmer waters encourage faster growth of the swimming A. catenella. Furthermore, the longer periods of calm weather and relatively calm seas from spring through fall allow the cells, which swim upward during the daytime, to accumulate in the surface waters. When enough of these cells collect in the upper water layer, the shellfish filtering them out for food become poisonous.

Shellfish filter water at remarkable rates; for example, a large oyster can filter as much as 30 liters (about 8 gallons) per hour. The more abundant the A. catenella cells, the faster the toxin content of the shellfish increases. The warming of the water also permits the shellfish to feed faster. These factors, when combined, may lead to PSP levels that require closures-just when the first good clamming tides of spring occur, causing disappointment and frustration for eager diggers.

Scientists believe that the cysts are as poisonous as the swimming cells and perhaps even more so. If large numbers of the cysts are present in the sediment, clams and other shellfish that consume them may become toxic at any time of the year.

Areas of PSP Occurrence

The accumulation of PSP toxins in shellfish is not a new phenomenon, nor is it one confined to Washington State. It has been occurring for hundreds of years in many parts of the world, primarily in temperate waters. Along the Pacific Coast, poisonous shellfish have been found all the way from Alaska to California. A member of Captain Vancouver's crew died in 1793 after eating toxic shellfish, the first recorded PSP death in the Pacific Northwest. Native Americans were undoubtedly aware of the problem long before that, however.

Since 1942, there has been an annual regulatory closure for mussels and all clams except razor clams in effect for the Strait of Juan de Fuca west of Dungeness Spit as well as the ocean beaches from April through October because of the occurrence of PSP. In the early 1970s, poisonous shellfish were found in the San Juan Islands and in the Bellingham area.

Before 1978, no cases of poisoning from shellfish harvested in Puget Sound east and south of Port Townsend had been reported, even though sparse populations of A. catenella were known to occur there. However, in the fall of 1978, extraordinarily high levels of PSP occurred in shellfish throughout the area between Whidbey and Camano islands. It is believed that as water from that area flowed southward around Whidbey Island, it carried enormous numbers of Alexandrium into the main basin of Puget Sound. As a result, shellfish became poisonous that year as far south as Des Moines.

In 1979, toxic shellfish were found in the Tacoma Narrows. Low levels of PSP were found in shellfish harvested just south of the Narrows in 1980, and throughout most of the southern basin, south of the Narrows in 1981. In 1988 high levels of toxins necessitated the first PSP closure of shellfish sites in the southern basin, in Case and Carr inlets.

In Hood Canal low levels of PSP have been found as far south as Bangor since 1978, but closures for PSP were not necessary in the Canal until 1992 when higher concentrations of toxins occurred as far south as Seabeck and Dabob Bay.
As of spring 1994, the only Washington waters that have never been closed to shellfish harvesting because of high levels of PSP are those of Hood Canal south of Seabeck.

Shellfish Subject to PSP

Unfortunately, all species of bivalve shellfish (clams, oysters, mussels, and scallops) commonly eaten in Washington have the potential to take up PSP toxins when A. catenella swimmers or cysts are present.

Different shellfish species vary considerably, however, in the rates at which they become toxic, in the total amounts of toxin they take up, in where the toxin is distributed in their bodies, and in the speed with which they get rid of it. Some kinds of shellfish are highly tolerant of PSP and can feed normally when A. catenella is abundant. This causes them to become very poisonous rapidly. Other kinds have a low tolerance to PSP and tend to reduce their feeding rates when A. catenella is abundant. They are thus less likely to become highly toxic. It is very rare that shellfish themselves are killed by the poison they consume.

In butter clams, much of the PSP toxin tends to become concentrated in the black tip of the siphon and is held there for varying lengths of time. This retention and also the consumption of cysts are probably what cause butter clams to be poisonous throughout the year in certain areas.

Razor clams tend to concentrate PSP toxins in their gut, which should be removed prior to consumption. Mussels tend both to take up and to lose the poisons rapidly. Since mussels normally locate on rocks and pilings, they are up out of the sediments where cysts accumulate. As a result, PSP in mussels is generally related to an abundance of swimming A. catenella and thus more likely to occur during the warmer months. Nevertheless, you should be forewarned that it is possible for mussels to become poisonous at other times if storms stir up the bottom dwelling cysts.

Paralytic shellfish poisons have also been found at low concentrations in several other kinds of marine life that some people like to eat, such as limpets, shore snails, moon snails, and hairy tritons. Several species of crabs have been found to contain small amounts, but not enough to cause concern. In Dungeness crabs, for example, the toxins have been found in the digestive tract.

PSP and Red Tides

Undoubtedly you have heard a great deal about red tides over the years. Unfortunately, there is much misunderstanding about the relationship between red tides and poisonous shellfish-including a widespread tendency to equate the two. This misconception has led to the dangerous false assumption that shellfish are safe to eat if red tide is not visible. On the other hand, some Northwesterners believe that because they have eaten shellfish safely for years even when red tides were present, they can continue to do so. It is essential to sort out the confusion. The term "red tide" is a misnomer since red tides are not tides at all, and many of them are not even red. Furthermore, "red tide" is widely used (even in dictionaries and on some beach closure signs) to indicate the presence of poisonous shellfish, when, in fact, only a very small percentage of the visible red tides cause shellfish to be unsafe. In Washington, most outbreaks of poisonous shellfish occur when there has heen no discoloration of the water at all.

Scientists use the term "red tide" to refer to an area of discolored water-usually amber, brown, purple, red, or pink-that is formed by accumulations of large numbers of microscopic plants or animals, hundreds of thousands per liter of water. A discolored area or red tide may be confined to relatively small patches, or it may cover several acres or even many square miles of the sea.

In the Pacific Northwest, there are many species of plankton that cause red tides. One of these is Mesodinium, a one-celled animal that frequently causes a red tide varying in color from brick red to purple. Another red tide you may have seen is the color of tomato soup; it is caused by Noctiluca, another dinoflagellate. Noctiluca, which means "night light," often produces a brilliant display of bioluminescence when the water is disturbed at night. Because it is very buoyant, it is frequently blown into windrows on the water or into bands of orange-red scum along the shore. Both of these red tides are harmless.

Of the many species that form red tides in Washington waters, A. catenella is the only one known to cause PSP. Water discolored by A. catenella varies from the color of weak tea to rusty-red, but "red tides" caused by this species are unusual in Washington waters. As mentioned, however, shellfish filter great volumes of water; thus this organism does not need to be very dense for the shellfish to collect enough poison to require that the beaches be closed to harvesting. In fact, most outbreaks of PSP in shellfish from Washington to Alaska occur when A. catenella is relatively sparse, not dense enough to discolor the water.

Keep in mind, then, that although a red tide may indicate that shellfish are toxic, it is dangerous to assume that lack of a red tide means that shellfish are safe to eat. Determining what shellfish gathering areas in Washington are safe or unsafe is the responsibility of the state and/or individual counties.

PSP Program in Washington

The Washington Department of Health began intermittent testing of shellfish for PSP in the 1930s, when there were many PSP illnesses and deaths in California. In 1942, harvesting of geoducks, horse clams, hard-shell clams, and mussels was prohibited on all beaches from Dungeness Spit to the Columbia River from April 1 through October31. This closure, based on annual recurrences of toxic shellfish except razor clams in that area, has been in effect every year since 1942 and is announced in the Sport Fisheries Regulations of the Washington State Department of Fish and Wildlife.

Warnings about poisonous shellfish on other Washington beaches are provided by a PSP monitoring program begun in 1947 after PSP deaths occurred in British Columbia. Under this program, counties have the responsibility for testing the shellfish on beaches used for recreational harvesting and then closing beaches to digging when PSP levels are too high. Landowners may contact local health agencies to see if arrangements can be made to test areas not regularly monitored for PSP. Testing and regulation of harvesting for commercial shellfish operations are the responsibility of the state.

Testing schedules vary, depending on the particular growing area and on the agency responsible. In general, some level of testing occurs from April through October at two-week intervals. Some areas are tested less frequently, whereas others are monitored regularly throughout the year. The state has initiated an early warning detection system using caged mussels to help predict outbreaks of PSP in other species of shellfish.

Shellfish samples are sent to the state's Public Health Laboratory for determination of toxin content by a bioassay method, the only one presently approved by the U.S. Food and Drug Administration (FDA). When toxin levels reach 80 micrograms per 100 grams of shellfish meat, closure of harvesting is required according to FDA regulations. The state closes commercial harvesting on an area-by-area basis, and county health departments close recreational harvesting areas as they deem necessary. Sometimes in a particular location, closures apply to only one or two species of shellfish, but not to other species with acceptable levels of PSP. The news media are notified of closures, and some-although not all-heavily used beaches are posted with closure signs.

State regulation of commercial shellfish harvesting following current procedures has resulted in an excellent record of protecting the public. Since the start of the program in 1957, only two cases of PSP (in 1988) have been caused by shellfish commercially harvested in Washington and sold in restaurants and retail stores.

Importance of Closures

Because an average person can eat an average meal of shellfish containing 80 micrograms and perhaps as much as 200 micrograms of toxin per 100 grams of shellfish meat without experiencing any PSP symptoms, many people think that the closure of beaches at the 80-microgram level set by the FDA is overprotective, and they ignore closure warnings. There are several important reasons, however, that make it pertinent to set the closure level at 80 micrograms per 100 grams of meat.

Distribution of A. catenella can be patchy and is generally not predictable in either timing or location. If some shellfish contain 80 micrograms on the day of testing, it is quite possible that they will contain much more poison a few days later or that shellfish on a nearby beach have much higher levels of toxin. A program based on higher closure levels would require that shellfish sampling be very closely spaced (every half mile in some situations) and done as often as two or three times a week. This is clearly not feasible because the cost of collecting and testing each sample currently exceeds $75 and because sampling more often than every two weeks when a low tide series occurs would be very difficult. As already explained, different species of shellfish vary in their rates of uptake and loss of poison. It simply is not practical in all cases to sample the species with the fastest uptake and the slowest loss rates. Another important factor is that people who eat shellfish differ markedly in weight, appetite, and response to the poison. Consumption of alcohol is thought to increase the effect of the toxin, adding still another variable.

All of these factors have been considered in establishing the level of acceptable toxin in shellfish tissue.