A norovirus outbreak associated with consumption of NSW oysters: implications for quality assurance systems

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Abstract

Norovirus is a common cause of gastroenteritis outbreaks associated with raw shellfish consumption. In Australia there have been several reports of norovirus outbreaks associated with oysters despite the application of regulatory measures recommended by Food Standards Australia New Zealand. This study describes an outbreak of norovirus gastroenteritis following the consumption of New South Wales oysters. In September 2007, OzFoodNet conducted a cohort study of a gastroenteritis outbreak amongst people that had dined at a Port Macquarie restaurant. Illness was strongly associated with oyster consumption, with all cases having eaten oysters from the same lease (RR undefined, $p<0.0001$). Norovirus was detected in a faecal specimen. Although no pathogen was identified during the environmental investigation, the source oyster lease had been closed just prior to harvesting due to sewage contamination. Australian quality assurance programs do not routinely test oysters for viral contamination that pose a risk to human health. It is recommended that the feasibility of testing oysters for norovirus, particularly after known faecal contamination of oyster leases, be assessed. *Commun Dis Intell* 2008;32:88–91.

Keywords: disease outbreak, environmental investigation, foodborne disease, norovirus

Introduction

In Australia, there have been several published outbreaks of norovirus, which have implicated oysters.[1–5] Between 2001–2006 in Australia, there were 13 outbreaks of gastroenteritis due to oysters reported to OzFoodNet; half of these outbreaks were due to norovirus (OzFoodNet, unpublished data, 2007). However, norovirus is a reasonably common gastroenteritis-causing pathogen in the community and disease can be mild. It is likely that there is significant under-reporting of norovirus gastroenteritis related to oyster consumption.

This report describes the epidemiological investigation of a norovirus outbreak following consumption of a meal at a northern New South Wales restaurant. The ability of current quality assurance control measures to protect the public from viral infections is questioned.

Methods

On 24 September 2007, Hunter New England OzFoodNet was informed of 19 cases of gastrointestinal illness amongst 54 individuals who had attended a golfing event in Port Macquarie in mid-September. Hypothesis generating interviews established that the point source of the outbreak was a restaurant dinner function on 11 September. This was the only meal shared by all cases and no attendees had been unwell at the function.

A retrospective cohort investigation of attendees of the function on 11 September was undertaken to identify the source of the outbreak. A questionnaire was administered by telephone between 25 and 28 September. Information was gathered regarding the onset and nature of any gastrointestinal illness, food and drink exposures, and contact with ill people.

A case was defined as a person who attended the restaurant for dinner and subsequently developed diarrhoea plus one or more additional symptoms of gastroenteritis (nausea, vomiting, abdominal pain, fever or lethargy).

Data were entered into a Microsoft Access database and then imported into STATA™ (version 8.0, Stata Corporation, College Station, Texas, USA) for analysis using Fisher's exact test for exploring rates by exposure status.

To investigate the environmental cause of the outbreak, the local council inspected the restaurant and the NSW Food Authority commenced a trace-back investigation of the oysters. This involved a site visit to the oyster wholesaler premises and to the oyster grower.

Faecal specimens were examined for parasitic, bacterial and viral pathogens by microscopy and culture, and enzyme immunoassay (EIA) and polymerase chain reaction for norovirus. Oysters obtained during the environmental investigation were tested for bacterial and viral pathogens.

Results

Cohort study

Interviews were undertaken with 53/54 people in the cohort, with one person being uncontactable. Nineteen cases were identified, with a median incubation period of 35 hours (range 10–59 hours) and the median duration of illness was 2.5 days (range 1–8 days). Two cases visited a doctor (11%), and no cases were hospitalised. All cases reported diarrhoea, and 18/19 (95%) experienced watery diarrhoea and one (5%) reported possible blood in the stool. Other symptoms reported included: abdominal pain (95%), lethargy (79%), nausea (79%), vomiting (58%), fever (58%) and headache (63%).

The dinner consisted of a choice of two entrée dishes, a buffet style main meal and a selection of desserts. The entrée choices were a plate of chicken skewers, served with risotto or a plate of six prawns and six natural oysters in the half-shell, served with cocktail sauce (served on the side) and lettuce garnish.

Illness was strongly associated with oyster consumption, with all cases having eaten oysters (RR undefined, $p<0.0001$) (Table). Other food items that were associated with illness included: prawns (RR=3.7, 95% CI 1.0–14.1), lettuce garnish (RR=2.8, 95%CI 1.4–5.5), cocktail sauce (RR=2.3, 95%CI 1.1–4.7), cucumber and tomato salad (RR=2.3, 95%CI 1.2–4.5) and pavlova (RR= 2.3, 95%CI 1.2–4.3). Stratified analysis could not be performed, as all cases consumed oysters.

Environmental investigation

The restaurant inspection found the facility to be compliant with the Australia New Zealand Food Standards Code[6] with no breaches in the handling or storage of food items.

The trace-back investigation identified that the estuary from which the oysters were harvested had been closed for three months prior to opening on 4 September, the day on which the implicated batch of oysters supplied to the restaurant was harvested. The estuary had been closed on 4 June due to rainfall, with continued closure due to a faecal spill from a sewage treatment plant near the oyster lease in the estuary on 20 August. The implicated oysters underwent post-harvest depuration for 36 hours, a process during which oysters are held in tanks of disinfected sea-water, allowing the oysters to feed in clean water prior to sale.[7] Quality assurance sampling performed post-depuration reported *Escherichia coli* <0.5 CFU/g, which is the limit of detection for the method used.

Table. Attack rates and relative risk for foods eaten at the restaurant dinner in Port Macquarie, 11 September 2007

Food	Ate			Did not eat			Relative risk	95% CI
	Ill n=19	Total	Attack rate (%)	Ill	Total	Attack rate (%)		
Entrée								
Oysters	19	34	55.9	0	19	0.0	undefined	
Prawns	17	37	45.9	2	16	12.5	3.7	1.0 – 14.1
Lettuce garnish	10	15	66.7	9	38	23.7	2.8	1.4–5.5
Cocktail sauce	11	20	55.0	8	33	24.2	2.3	1.1–4.7
Chicken skewers	1	16	6.3	18	37	48.6	0.1	0.0–0.9
Main course								
Leg ham	17	40	42.5	2	13	15.4	2.8	0.7–10.4
Lamb	15	42	35.7	4	11	36.3	1.0	0.4–2.4
Beef	11	41	26.8	8	12	66.7	0.4	0.2–0.8
Chicken	12	37	32.4	7	16	43.8	0.7	0.4–1.5
Cucumber and tomato salad	5	7	71.4	14	46	30.4	2.3	1.2–4.5
Dessert								
Pavlova	6	9	66.7	13	44	29.5	2.3	1.2–4.3
Toffee pudding	0	6	0.0	19	47	40.4	0.0	–
Apple strudel	3	6	50.0	16	47	34.0	1.4	0.6–3.6
Fruit salad	3	8	37.5	16	45	35.6	1.1	0.4–2.8
Cream	11	25	44.0	8	28	28.6	1.5	0.7–3.2

The environmental investigation revealed that there were no sick food handlers at the time of the function, either at the restaurant, wholesaler or oyster farm.

Microbiology

Faecal specimens were collected from only one case. Of two collected specimens, one was tested by EIA and found to be positive for norovirus.

Fresh oysters obtained during the environmental investigation were negative for pathogens, including norovirus, but were from a different batch to that consumed on the night of the function.

Discussion

This outbreak of norovirus gastroenteritis was associated with oyster consumption. While consumption of prawns, lettuce and cocktail sauce were associated with illness, their association was likely to represent confounding, as the oysters were served on a plate with these food items. All of those cases that ate prawns (n=17), lettuce (n=10) or cocktail sauce (n=11), had also consumed oysters (n=19). Other foods (cucumber and tomato salad and pavlova) accounted for fewer cases of illness (5/19 and 6/19 respectively).

This study highlights the importance of quality assurance processes within the oyster industry. In New South Wales there is a mandatory, industry-funded Shellfish Program, which is administered by the NSW Food Authority.[8] The NSW Shellfish Program incorporates the principles and objectives of the Australian Shellfish Quality Assurance Program.[9] Quality assurance programs monitor *E. coli* and faecal coliforms as indicator organisms for contamination of shellfish.[9]

Reviews of foodborne viral illness have suggested that bacteriological testing of shellfish provides an unreliable indication of viral contamination.[4,10] Several studies have detected norovirus in oysters which have met bacteriologic standards required for human consumption.[11,12] In addition, shellfish have the ability to accumulate viruses in their digestive tracts to levels that are much higher than those of the surrounding water.[10] One study found that Eastern oysters accumulate a viral surrogate, F+ coliphage, to densities that were on average 19 times greater than the levels in the surrounding estuarine water.[13]

Although depuration effectively decreases bacterial levels, including *E. coli*,[7,10] it is generally accepted that this process is inadequate for viral decontamination.[10,14] It has been demonstrated experimentally that radio-labelled virus particles can persist in oysters for 64 hours after depuration.[15]

While norovirus usually causes a mild illness, its presence may indicate increased risk of other viruses, including hepatitis A.[16] Some have suggested that warning labels accompany oysters at points of sale to warn of the potential risks.[14,17] An alternative could be to test specifically for norovirus and other viral pathogens, however, the cost effectiveness and feasibility of this in Australia would require evaluation.

Several countries in the Asia-Pacific region are currently evaluating or instituting norovirus testing of oysters. In 2007, the Agri-Food and Veterinary Authority (AVA) of Singapore introduced the mandatory testing of imported oysters.[18] The AVA requires all consignments of frozen oysters to be tested by the exporting country and certified as being free from norovirus.[18] In New Zealand, the Environmental Science and Research (ESR) laboratory is working with the New Zealand Food Safety Authority to improve methods for norovirus testing of shellfish.[19] The goal of the ESR oyster research program is to establish protocols and quality systems suitable for regulatory use in New Zealand.[19]

Conclusion

Epidemiological evidence from this cohort study showed a significant association between oysters and gastroenteritis. Although environmental evidence was lacking, a potential mechanism for viral contamination leading to accumulation of virus within the oysters was the reported sewage spill in the vicinity of the oyster lease less than two weeks prior to harvesting. Current quality assurance systems may be inadequate to guarantee public safety from viral contamination of oysters. The feasibility and cost effectiveness of enterovirus testing of oysters, particularly after high risk events such as faecal spills, should be further evaluated.

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