NORWALK-LIKE VIRUSES

THE ORGANISM/TOXIN

The Norwalk-like viruses (NLVs), including Norwalk virus itself, are now the most widely recognised viral agents associated with food and waterborne outbreaks of non-bacterial gastroenteritis world-wide. They were previously known as small round structured viruses (SRSVs). The identification of the NLVs has been difficult prior to development of molecular methods because they are nonculturable, there is no animal model, and they show great genetic diversity. These factors limit the use of traditional immunology and serotyping assays. A large number of genetically diverse NLV strains associated with gastroenteritis outbreaks have now been characterised. NLV strains are named after the location of the outbreak from which they were first derived eg. Norwalk virus, Mexico virus, Hawaii virus, Bristol virus, Southampton virus.

GROWTH AND ITS CONTROL

Growth: Norwalk-like viruses cannot be grown in cell culture or human embryonic intestinal organ culture, and there is no known animal model. Detection and characterisation of NLV strains are carried out using molecular methods, including DNA sequencing. It cannot grow in food.

Survival: Survival data are based on human dose response research studies. These studies indicate that the virus is stable and resistant to heat, acid and solvents.

Inactivation: Only limited information is available.

Temperature: The virus retained infectivity after incubation at 60°C for 30 min. Pasteurisation is not sufficient to eliminate viruses. Resistance is reported to be greater in foods and shellfish. Steaming of oysters may not inactivate NLVs.

Under refrigeration and freezing conditions the virus remains intact (and presumably viable) for several months, possibly years. Freezing generally does not inactivate viruses.

pH: Resists gastric acids at pH 3-4. The virus retained infectivity after exposure to pH 2.7 for 3 hours at room temperature. Believed to be sensitive to pH >9.0 but unproven.

Water activity: Little published data available but probable that NLVs persist in waters and shellfish for extended periods (possibly weeks or months).

Drying: Resistant. Survived on environmental surfaces, including carpets, for up to 12 days after NLV outbreaks in institutions.

Preservatives: Since the organism does not grow in food, this will not be controlled by preservatives.

Sanitisers/Disinfectants: (These products must be used as advised by the manufacturer).

Resistant to inactivation following treatment with 3.75 to 6.25 mg chlorine/l (free residual chlorine of 0.5 to 1.0 mg/l). This level of free chlorine is consistent with that generally present in a drinking water supply. Inactivated following treatment with 10 mg/l of chlorine.

The virus retained infectivity after exposure to treatment with 20% ether at 4°C for 18 hours.

(N.B. The absence of a sanitiser/disinfectant from this section does not necessarily imply that it is ineffective).

Radiation: Unknown

THE ILLNESS

Incubation: 10-50 hours (mean of 24) following ingestion of the virus.

Symptoms: Vomiting, often projectile, is generally the predominant symptom and is present in > 50% of cases. Stomach cramps, diarrhoea, abdominal pain, low-grade fever and headache are other common symptoms. The duration of illness is usually between 24-60 hours. Excretion of the virus in stools occurs from onset for up to 1-2 weeks following infection. High levels of virus may also be discharged in vomit. The disease is generally mild and self-limiting. Hospitalisation is not generally required, but has been reported in some outbreaks. US data assumes NLVs account for 11% of 452000 annual hospitalisations for viral gastroenteritis. The attack rate is generally around 40-60%. The overall attack rate in New Zealand outbreaks is estimated at 40%, but may be higher as many cases are unreported.

Condition: Norwalk-like viruses colonise the proximal region of the small intestine and cause development of mucosal lesions. Short-term maladsorption of fats and some sugars has been reported. The exact mechanism of pathogenesis remains unclear.

Toxins: Unknown.

At Risk Groups: Affects all age groups, but the elderly and the immunocompromised are particularly susceptible.

Dose: Infective dose is estimated at 1-10 particles. Consumption of 1 virus particle causes infection on approximately 20% of occasions. Levels shed in faeces are ~10^6 viruses/g. 10^5-10^6 infectious doses can also be generated per vomiting incident.

NZ Incidence: NLVs were the leading cause of communicable disease outbreaks in 1999. In New Zealand, most outbreaks occur in summer and autumn. This contrasts with that observed in

Australia, where the seasonal peak occurs between August and December, and also with the United Kingdom where disease more commonly occurs in the winter months between September and March. There are no data on the incidence of sporadic NLV infection in the New Zealand. A prospective population-based study in England found an annual incidence of NLV infection of 1250/100 000. If this rate is applied in New Zealand, approximately 45 000 episodes of NLV gastroenteritis a year could be expected. In the United States, NLV infection is now classed as the major cause of foodborne disease, responsible for at least 9 million cases per year. Increasing annual rates in New Zealand and these countries are being recorded.

Treatment: Usually none, but fluids may be given to reduce the risk of dehydration.

SOURCES

Human: The only known reservoir for NLVs is human faeces. Other reservoirs could be shellfish, animals and the environment but currently there is no definitive evidence to support this.

Animal: Related caliciviruses are found in various animal species, but cross-species transmission has not been reported**.**

Food: Contaminated bivalve shellfish, salads, water and ice, and manually prepared food products (including bakery items) via food handlers. Poor hygiene practices are a major factor.

Environment: Excreta from infected humans may contaminate soil or water. Environmental survival is considered to be good. Faecal pollution from sewage discharges, septic tank leachates and boat discharges has caused contamination of shellfish beds, recreational water, irrigation water and drinking water.

One outbreak occurred among carpet layers from carpet which had become contaminated 12 days earlier in a rest home outbreak.

Transmission Routes: The faecal / oral route is the established route of transmission and infection occurs following ingestion of faecally-contaminated food and water. Other routes are also implicated; these help explain the explosive outbreaks that cannot be attributed to faecal / oral spread alone and which occur in semi-closed communities such as rest homes, cruise ships, and camps. Person-to-person spread via aerosolised vomit following projectile vomiting is another route of spread. The role of asymptomatic carriers is unclear, but there is evidence that asymptomatic foodhandlers cause infection. Direct transmission via contaminated surfaces, especially carpets and toilet seats, is also now considered a significant route.

OUTBREAKS AND INCIDENTS

Outbreaks: Most identified cases of disease are outbreak- related. Because of the relatively high attack rate large numbers of people are often infected. Little information is available on the prevalence of sporadic cases. In New Zealand outbreaks are most commonly attributed to either foodborne or person to person contamination. Most foodborne outbreaks are caused by cross contamination via a foodhandler or inadequate cooking of previously contaminated foods. However, any food that becomes contaminated can act as a vehicle. Uncooked or lightly cooked bivalve shellfish such as oysters and mussels present a risk to health if grown in faecally contaminated waters.

New Zealand Outbreaks:

Shellfish: Contaminated commercially–grown oysters were associated with 10 gastroenteritis outbreaks comprising 86 cases. The same strain of NLV was found in both oysters and faecal specimens of cases. Control point failure: contaminated growing waters.

Water: A large outbreak was caused via drinking water at a ski resort. Control point failure: contamination of untreated supply.

Buffet Lunch: 62 cases infected at a hotel lunch. Control point failure: contamination by food handler.

Overseas Outbreaks:

Shellfish: US multistate outbreaks. Control point failure: contamination of growing waters.

Water: >118 cases among bus passengers and staff in Alaska. Control point failure: contamination of untreated water.

Bakery goods: 129 confirmed cases but estimated over 3000 cases in total based on 60% attack rate. Control point failure: cake icing contaminated by food handler.

Meat sandwiches: 9 cases. Control point failure: contamination of sandwiches by foodhandler caring for sick child.

Potato salad: 47 cases associated with consumption of potato salad. Control point failure: cross contamination from vomit (in same sink as used for preparation.

Epidemiology: Accurate figures for incidence of NLV disease are not available. It is not a notifiable disease and is believed to be greatly under-reported in NZ and overseas**.** However, it is recognised as a major cause of foodborne gastroenteritis and of institutional outbreaks involving person to person transmission**.** NLVs were responsible for the highest number of cases of outbreak-associated gastroenteritis occurring in New Zealand in 1999 and 2000.

ADEQUATE PROCESSING GUIDELINES

N.B. These guidelines have been derived from published information. Industry is advised to ensure that processing steps they are using are adequate to meet their particular food safety objectives.

Cook	Internal temperature reached	Time
Shellfish (temperature required to ensure inactivation of Hepatitis A virus)	90^{o}C	1.5 min
Thoroughly wash all fruit and vegetables with potable water		
Ensure shellfish are harvested from approved shellfish gathering waters		
Avoid direct handling of food by infected food handlers		
Ensure all foodhandlers are trained in effective handwashing techniques (asymptomatic foodhandlers can cause infection)		
Thorough cleaning and disinfection must follow vomiting on food premises		
Boil, filter or chemically treat non-potable water for drinking		

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