A Gastroenteritis Outbreak due to Norovirus Infection in Xanthi, Northern Greece: Management and Public Health Consequences

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Abstract

A gastroenteritis outbreak was observed in the town of Xanthi on Jan 28, 2005. A total of 709 patients (350 males and 359 females, mean age 23.8 ± 19.95 years) visited the local hospital over a period of two weeks with symptoms of fever (22.3%), abdominal pain (78.6%), nausea (85.5%), vomiting (67.1%) and diarrhea (72.5%). PCR for Norovirus in randomly selected stool specimens examined was positive in all cases (8/8). No other pathogen was revealed. As 85.1% of the primary affected individuals had been using water from a single well (supplying approximately 40% of the 34,889 inhabitants), and water specimens from this well were found to carry a high bacterial load, the waterborne transmission of Norovirus was the main suspected cause of the outbreak. People were advised to consume bottled water and to wash their hands carefully especially after toilet use until the remission of the outbreak. Additionally, more chloride was added to the suspected well (10 ppm or 10 mg/l). Fourteen days later, the outbreak waned and all measures were withdrawn.

Key words

Gastroenteritis - outbreak - Norovirus

Rezumat

O epidemie de gastroenterită a fost înregistrată în oraşul Xanthi la 28 ianuarie 2005. Într-o perioadă de 2 săptămâni 709 pacienți (350 bărbați, 359 femei, vârsta medie 23,8 ± 19,95 ani) s-au prezentat la spitalul local pentru febră (22,3%), durere abdominală (78,6%), greață (85,8%), vărsături (67,1%) şi diaree (72,5%). PCR pentru Norovirus efectuată la mostre de scaun alese randomizat a fost pozitivă în toate cazurile (8/8). Nu s-au decelat alți agenți patogeni. 85% dintre pacienți folosiseră aceeaşi sursă de apă (dintr-un izvor aprovizionând 40% din populație), iar mostrele prelevate de la sursă prezentau o încărcare bacteriană înaltă. S-a suspectat ca etiologie principală a epidemiei Norovirus (OR 8,8, 95% CI 6,6-11,5). Oamenii au fost sfătuiți să consume apă îmbuteliată şi sa-şi spele atent mâinile după folosirea toaletei. Mai mult, rezervorul de apă suspect a fost dezinfectat cu cantități crescute de clorură (10 ppm sau 10 mg/L, pentru mai mult de 30 minute). După 14 zile epidemia s-a stins şi toate măsurile au fost sistate.

J Gastrointest Liver Dis
March 2006 Vol.15 No.1, 27-30
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Introduction

The etiology of gastroenteritis outbreaks remained in many cases obscure before the discovery of potent viral causative agents (Norwalk-like viruses or Noroviruses or NLV (1), Rotaviruses (2) and Astroviruses (3)) in the early 1970s. Difficulties concerning the direct detection of NLV led to the establishment of other criteria which alternatively could be used to characterize a gastroenteritis outbreak as "of potent NLV etiology": a) stool specimens negative for bacteria and parasites, b) cases with vomiting > 50%, c) mean duration of illness 12-60 hours and d) mean incubation period of 12-24 hours (4).

Certain sensitive molecular assays developed some twenty years later (ELISA, RT-PCR, nucleotide hybridization probes and baculovirus-expressed viral antigens) enabled the documentation of the etiological pathogen (5-8). Based on these assays, it was realized that the majority of the gastroenteritis outbreaks in various countries were of NLV etiology. A total of 5-17% of gastroenteritis cases worldwide are caused by NLV.

Norwalk virus is the prototype strain of genetically and antigenically diverse single-stranded RNA viruses of the NLV, which include three distinct genotypes: GI, GII and GIII. Norwalk-like viruses along with "Sapporo-like viruses" are classified in the family Calciviridae (9, 10).

Gastroenteritis due to NLV is characterized by acute onset of abdominal cramps, nausea, vomiting, diarrhea and

low fever. Vomiting is more prevalent among children. About 0.5% of the hospitalized cases succumb (11).

Fecal-oral spread is the primary transmission mode of NLV gastroenteritis. Following primary cases, secondary cases can result from person-to-person transmission. Among 348 NLV gastroenteritis outbreaks, food was responsible for 39%, person-to-person contact for 12% and water for 3% of them (12-17).

According to investigations carried out in volunteers, 82% of the persons who are exposed to NLV are infected; of these, 68% develop gastroenteritis. NLV remains detectable even 7 days after infection (18). The high percentage of infected individuals is explained by the low viral load that can result in illness (even <100 viral particles) (19). Additionally, the relative resistance of NLV to chlorine and its ability to survive both at freezing temperatures and at 60°C, facilitates its spread. Thus, high-level chlorination (i.e., 10 ppm or 10 mg/L for >30 minutes) might be required for adequate disinfection; however, even this method might be insufficient in certain cases (20). The multiplicity of NLV strains does not pactically allow complete cross-protection (21). Moreover, many asymptomatic NLV carriers exist especially in crowded environments (22).

The present work is focused on a Norovirus gastroenteritis outbreak that was observed in the town of Xanthi, Northern Greece. Incubation period, duration of illness, prevailing symptoms, potent source along with the management of the situation are discussed.

Methods

Seven hundred and nine consecutive patients who visited the Emergency Department of the General Xanthi Hospital with symptoms of acute gastroenteritis between January 28, 2005 and February 10, 2005 were enrolled in the study.

A detailed medical record including gender, age, time of onset of the disease as well as the presence of fever, abdominal pain, nausea, vomiting and diarrhea and consumption of suspicious food was collected from each patient.

The address of each patient was located on a town map as a red dot. Two districts were discriminated according to the water supply; one corresponding to the "Paradisos source", representing 60% of the citizens (or 20,933 people as the population of Xanthi counted 34,889 citizens in the last consensus) and the other to the "Drosero" well, representing the remainder.

Water specimens were collected from the points where the majority of the gastroenteritis cases had been referred for chemical and bacteriological analysis. Free chloride was measured and bacteriological cultures were examined after incubation in proper conditions before (Jan 30, 2005) and after (Feb 2, 2005) the application of high-level chlorination (10 ppm or 10 mg/L for several hours).

Stool specimens, during the acute phase of illness, were also collected from the first 8 patients and were examined for Salmonella, Shigella, Campylobacter, Yersinia, Enterotoxic E. coli, Enterohaemorrhagic E. coli as well as for the presence of enteropathogenic viruses.

Chi-square test was used to compare discrete parameters. The level of statistical significance was set at $p<0.05$.

Results

From the total of 709 cases, 359 (50.63%) were female and 350 (49.37%) were male patients. The mean age of affected individuals was 23.57 ± 19.95 years, and 262 cases (36.95%) were pediatric cases (Fig.1).

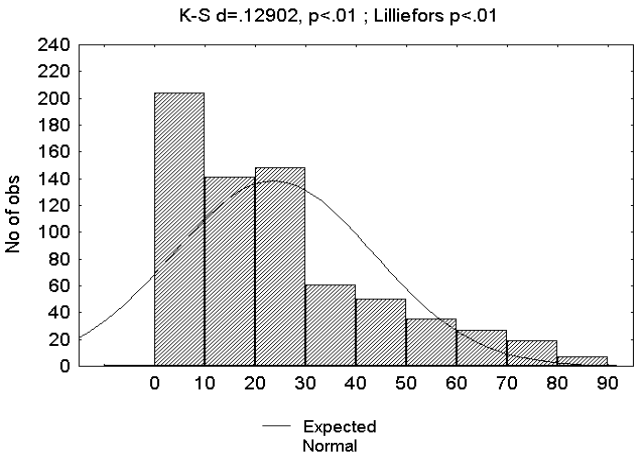

Fig.1 Histogram presenting age distribution of cases. The majority of cases refer to young people (under 30 years).

From all affected individuals, 158 (22.3%) presented fever, 557 (78.6%) abdominal pain, 606 (85.5%) nausea, 476 (67.1%) vomiting and 514 (72.5%) diarrhea.

No fatal cases were reported. Eighteen cases (2.54%) were hospitalized. An 83 year-old man developed acute renal failure, which was successfully treated.

PCR for Norovirus in stool specimens examined was positive in all cases (8/8). No other viral or bacterial pathogen was revealed.

The bacteriological cultures of water specimens from "Drosero" well revealed a huge load of E. coli, Enterococcus, Clostridium and Psudomonas spp. In contrast, the water specimens from "Paradisos" source did not contain bacterial pathogens. Unfortunately, virological examination of these specimens was technically not possible (20).

Fig.2 depicts the course of the number of gastroenteritis patients who visited the Emergency Department of Xanthi General Hospital.

During the first 96 hours, the spatial distribution of the gastroenteritis cases in the town map indicated that 85.1% (337/396) of them derived from the district which received water from "Drosero" well (Fig.3). Using Chi-square (goodness of fit) a strong relation of the gastroenteritis cases with the "Drosero" well was documented ($p<0.0001$).

As the waterborne transmission of the outbreak was prominent, the Regional Public Health Bureau announced that water use was forbidden (Jan 29, 2005) and recommended

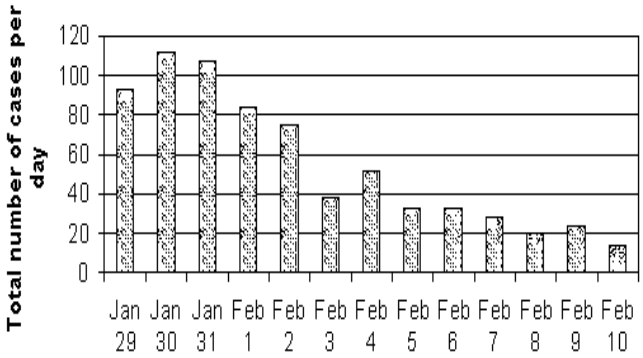

Fig.2 Chart depicting the course of gastroenteritis outbreak during the first two weeks.

frequent handwashing and the use of masks and gloves before approaching potentially soiled surfaces. Moreover, high-level chlorination (10 ppm or 10 mg/L for several hours) was applied to "Drosero" well as a measure of adequate disinfection (Jan 30, 2005) (20).

Fig.3 Map of the town of Xanthi where all cases during the first 4 days of the outbreak are represented as dots.

Discussion

The clinical course of the gastroenteritis due to Norovirus was extensively observed throughout the relative outbreak. Abdominal pain, nausea, vomiting and diarrhea were the prevailing symptoms. Controversially, only a small part of patients presented a slightly elevated temperature.

It has been stated that the gastroenteritis caused by Norovirus are mainly due to food (39%) and person-to-person contact (12%). Not more than 3% of these cases are due to water (23). In an outbreak, the primary cases, which are mainly due to foodborne transmission (and less commonly to waterborne transmission), are followed by the secondary and tertiary cases, which are mainly due to person-to-person transmission (by the means of fecal-oral or airborne transmission). Although the interruption of the outbreak in the phase of secondary and tertiary cases is difficult, certain simple public health measures, as frequent handwashing with soap and water, may help (24).

Although waterborne outbreaks are far less common than foodborne outbreaks, NLV gastroenteritis outbreaks has been associated with sources of contaminated water, including municipal water, well water, stream water, commercial ice, lake water, and swimming pool water. Because current analytic methods do not permit direct monitoring of NLVs in water, indicator organisms (e.g., coliform bacteria) have been used as proxy indicators of fecal contamination. However, because the size, physiology, and susceptibility to physical treatment and disinfection of bacterial indicators differ from those of NLVs, inherent limitations of this approach exist. Until reliable methods for assessing the occurrence and susceptibility to treatment of NLVs are available, prevention methods should focus on reducing human waste contamination of water supplies. If drinking or recreational water is suspected as an outbreak source, high-level chlorination (i.e. 10 ppm or 10 mg/L for >30 minutes) might be required for adequate disinfection; however, even this method might be insufficient in certain cases (20).

Figure 2 shows that the peak of the outbreak was observed between Jan 29 and Jan 30, while the majority of cases were encountered in the first 5 days. Taking into consideration that the mean incubation period is 12-24 hours, the most suspicious event that could have been responsible for the contamination of the "Drosero" well was a waterflood which resulted from heavy rain during the night of Jan 27.

Although there is no accurate definition for "primary" and "secondary" cases, we used the hypothesis of the infected well (serving to define suspicious area of primary cases) which happened during the heavy rain and remained until the overchlorination of water as well as the period of incubation of Norovirus (serving to define the suspicious period of primary cases) to discriminate between them for the purpose of the analysis. Thus, we included all cases which had been considered as primary from the above mentioned point of view. These cases included mainly those who have been observed within the first 96 hours (counted as the sum of the 72 hours between the estimated contamination of water and the disinfection by overchlorination plus the maximal 24-hour period of incubation of Norovirus). Cases who had been considered as secondary (infected members of a single family, delayed for more than 24 hours regarding the first case within the family, or infected individuals who live far from the suspicious

area and had developed symptoms after close contact with primarily infected individuals) had been excluded from the analysis.

It is thus hypothesized that forbidding water use, two days after its contamination, in combination with the application of high-level chlorination in the suspected well, resulted in the reduction of the number of primary cases. Meanwhile, the suggestion of frequent handwashing limited the secondary cases due to preson-to-person contact, although a relatively small number of them were inevitable as they might have evolved before the announcement of Public Health measures.

The measures that were taken helped the community to overcome the problem in a relatively short time. After two weeks (Fig.2), the number of gastroenteritis cases fell to the usual levels.

As a conclusion, it must be stated that the rapid and accurate detection of the causative agent, the definition of the source of contamination and the adoption of proper and sufficient measures stand as prerequisite for the suppression of a gastroenteritis outbreak, before the si-tuation becomes incontrollable and the cost intolerable (25).

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