

Investigating a community wide outbreak of hepatitis A in Kerala, India

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ABSTRACT

Background: There was an outbreak of acute hepatitis in Nellikuzhy panchayat of Kothamangalam taluk, Ernakulam district, Kerala, during November and early December 2016. Objective of this study is to describe the epidemiological features of the outbreak and to identify the probable source. **Materials and Methods:** The outbreak was defined in terms of time, place, and person. A hypothesis was generated and tested using a case-control study. Cases were selected by simple random sampling from the line list and controls were age-matched neighborhood individuals without any history of jaundice. Chi-square test, univariate analysis, and multi-variate logistic regression analyses were done to identify the probable risk factors. **Results:** Around 223 hepatitis A cases were identified. Attack rate was found to be highest among the age group of 16-30 years at 1.44% and was eight times higher among males. Epidemic curve suggested a point source outbreak possibly from exposure to food or water from a newly opened hotel in the area. The case-control study confirmed the hypothesis with a statistically significant association between cases and history of exposure to food from the hotel [OR 120; 95% CI 14.6-996.2; *P* value < 0.001]. **Conclusion:** Observations and results of the case-control study revealed that the probable source of the Hepatitis A outbreak at Nellikuzhy panchayat was a hotel. The study findings also add evidences to the changing epidemiological pattern of hepatitis A in Kerala, and warrant the necessity to enforce food safety rules in the State.

Keywords: Hepatitis A, outbreak investigation, water quality surveillance

Introduction

Several outbreaks of hepatitis A have been reported from Kerala State in recent years.^[1-10] Weekly reports of outbreaks retrieved from the official website of Integrated Disease Surveillance Project showed that there were 84 outbreaks of hepatitis A reported from Kerala in the past 5 years.^[9]

An extensive outbreak of acute jaundice occurred at Nellikuzhy panchayat, Kothamangalam taluk of Ernakulam district with more than 200 cases during November and early December 2016. An outbreak investigation was initiated with the objectives to

describe the epidemiological feature of hepatitis outbreak in Nellikuzhy panchayat and to make recommendations to further prevent the spread of the disease.

Materials and Methods

The following systematic steps were followed in investigating the outbreak. Current incidence of hepatitis in the area was compared with the background rates reported to Integrated Disease Surveillance Project from the area. Possibility of an artifact in the form of improved surveillance or mass population movements was excluded, based on discussions with the primary healthcare team and the local leaders. The team visited eight cases initially and sent their blood samples for confirmation.

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The defined area had a total population of 45,981 with 23,200 males and 22,781 females. Divided into 21 wards, Nellikuzhy panchayat had 11,734 dwelling houses. There were 3,880 families holding BPL ration cards. Water supply to the area was mainly through wells. There were 8,270 wells as enlisted by the primary healthcare team. There were 11 small-scale public water supply scheme supplying water to 3,222 households.

The primary healthcare team did house-to-house visit for searching hepatitis A cases. A probable case of hepatitis A was defined as an acute illness with fever or loss of appetite followed by yellowish discoloration of sclera or urine after October 1, 2016 in a resident of Nellikuzhy. A line list of cases was developed with information regarding the date of onset, age, sex, and place of residence. The catchment area hospitals and traditional healers were visited to finalize the line list. Surveillance was strengthened in nearby areas.

Attack rates of acute hepatitis by age and sex were calculated. An epidemic curve [Figure 1] was drawn and a spot map was generated. Key informant interviews were conducted with seven health workers of the area, three leaders of local self-government, and eight cases who developed the disease. Information regarding the source of drinking water, drainage system, important events before the onset of illness, public gatherings, and exposure to outside food and local food vendors were collected.

Hypothesis was generated and a case-control study was planned to test the hypothesis. Cases were selected using simple random sampling from the line list prepared. Controls were age-matched neighborhood individuals with no history of jaundice. Those with previous history of jaundice were also excluded. For each case, one age (± 5) matched control living in the house with the next number was included. If there was no eligible control in the neighborhood house, the houses were visited serially until an eligible control was obtained. With a 95% confidence, 80% power, expected proportion of controls exposed (Hotel Spice Village) as 10% and assumed odds ratio (OR) of 5, minimum sample size calculated was 42 in each group.

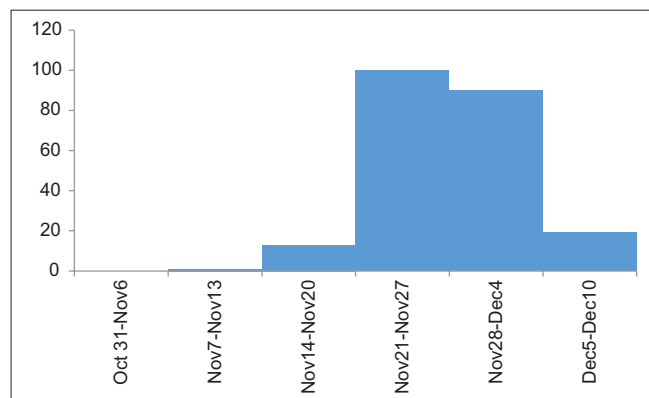


Figure 1: Epidemic curve showing time distribution of hepatitis A cases, Nellikuzhy, October 1–December 10, 2016

All the cases and controls were interviewed at their home using a structured questionnaire, which included information regarding the demographic characteristics, source of water, personal hygiene, treatment of water before consumption, habit of consuming food from outside, and past history of hepatitis. Consumption of food from a newly opened hotel was specifically probed. The date of consumption and the items consumed from this particular hotel were enquired. The list of other hotels from which they consumed food during last two months was also collected. Data were analyzed using Statistical Package for Social Sciences version 12 (SPSS Inc., Chicago, IL, USA), for Microsoft Windows. Chi-square test for any associations and ORs with confidence intervals (CIs) were estimated to identify the risk factors associated with HAV infection.

Results

A diagnosis of hepatitis A was confirmed as all the samples sent were positive for IgM HAV. As on December 10, 2016, 223 cases were identified. Attack rate [Table 1] was found to be more in the age group 16–30 years, followed by 31–45 years and then 5–15 years. Males had an attack rate almost eight times higher than that of females. Spot map showed that cases were distributed in almost all central wards of Nellikuzhy Panchayat. The epidemic curve showed a rapid rise in number of cases followed by a fall with majority of cases within one incubation period pointing to the possibility of a point source epidemic (i.e., all the cases were exposed at a particular time). The epidemic started during third week of November (14th to 20th) and had its peak during the fourth week of November (21st to 27th) and last week (November 28 to December 4).

All the hypothesis developing interviews pointed to probable source as exposure to food/water from the newly opened hotel in the area. The hotel was inaugurated on 24 October, 2016. Being a new hotel and a reasonably big one in the area, many people from the place had visited the hotel. No other factor emerged as a possible source of outbreak from the interviews. The possibility of pipeline contamination was prompted by the researchers, but all the key informants denied this as many of the houses with cases did not have piped water distribution and cases

Table 1: Attack rate of hepatitis A, Nellikuzhy Panchayat, 2016

	Number of hepatitis A cases	Total population in the age group	Attack rate (%)
Age group (years)			
<5	2	3,208	0.06
6-15	20	6,703	0.30
16-30	142	9,858	1.44
31-45	57	10,762	0.53
46-60	2	9,296	0.02
>60	0	6,154	0
Gender			
Male	198	23,200	0.85
Female	25	22,781	0.11

were not along the water supply distribution of any single source piped water line and the 11 small-scale pipelines supplying water to these areas were not interconnected. The possibility of well contamination through water movement from canals was also probed, but there was no such increase in water levels noticed in wells in this area during 2016.

On analyzing the reports collected by the primary healthcare team, it was found that 22 out of 223 hepatitis A cases had no exposure to food/drinks from the suspected hotel. A separate line list was prepared for these cases. Epidemic curve of those 22 cases were drawn separately and it was observed that majority (90.9%) of those 22 cases had their disease onset between last week of November and first week of December. The team interviewed 14 of those 22 cases. One case gave history of consuming lime juice from the hotel, whereas 9 out of 14 had a clear history of contact with a case of hepatitis A that occurred during 2nd and 3rd week of November.

Evidences from the distribution of cases, epidemic curve, analysis of epidemiological case sheets, key informant interviews, and environmental observations, pointed to the possible cause of hepatitis A outbreak in Nellikuzhy panchayat as exposure to food/water from a newly opened hotel during late October 2016.

In total, 41 cases and 40 age-matched controls were interviewed. Mean age of cases was 26.9 (SD 9.84) and that of controls was 27.1 (SD 11.17). Analysis of factors showed that having consumed food from the suspected hotel was significantly associated with hepatitis A cases (OR 120, *P* value < 0.001) [Table 2].

Discussion

The results of case–control study conclusively proved the hypothesis that the point source of hepatitis A outbreak that started around mid-November 2016 in Nellikuzhy panchayat was a newly opened hotel at Nellikuzhy. From the food item consumption pattern of cases, environmental observation and anecdotal evidences, it could be speculated that the source had something to do with water or ice, as 30 of 31 cases who consumed food from the hotel confirmed that they had consumed ice or water in the form of juice [Figure 2]. However, this needs to be investigated further. The 21 cases which developed during late November and early December could probably be due to person-to-person transmission that happened in the area.

Though hepatitis A is a self-limiting viral disease, it causes significant morbidity. Most people with hepatitis A feel sick for about 2 months and many need hospital care. People affected with HAV may take a few months to return to work, school, or daily life, and so, HAV infections can lead to economic losses and social consequences in the community. A study report showed that average out of pocket expenditure, including direct and indirect expenses, to a family due to one of its member affected with hepatitis A in Kerala as Rs. 24,025 (SD Rs. 8,315). When the disease is shifting to higher age group, as seen in Kerala, it leads to severe manifestations and fatality.^[11]

Presentation of disease is determined by the age of exposure, which tends to be asymptomatic and adults. Infected children under 6 years of age do not usually experience noticeable symptoms, and only 10% develop jaundice, but they often pass the disease to others. Among older children and adults, infection usually causes more severe symptoms, with jaundice occurring in more than 70% of cases. Immunity after infection is probably life-long. In areas with very poor sanitary conditions and hygienic practices, most children have been infected with the hepatitis A virus before the age of 10. Those infected in childhood do not experience any noticeable symptoms but will develop life-long immunity. So, outbreaks of HAV are uncommon in areas with very poor sanitation because older children and adults are generally immune, as they contracted the disease during childhood. Symptomatic disease rates in these areas are low and outbreaks are rare.^[13-15]

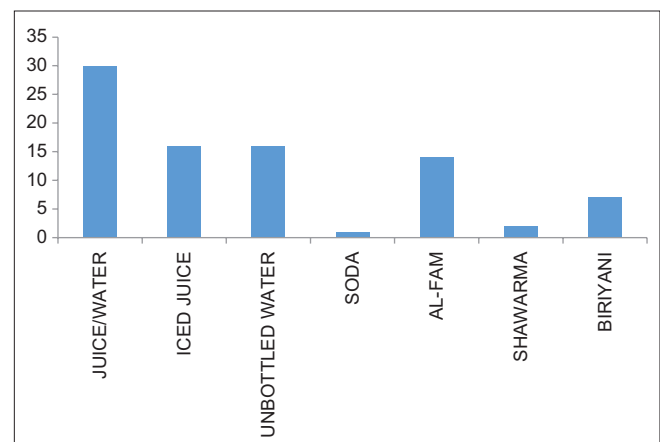


Figure 2: Pattern of food consumption from "Hotel X"

Table 2: Factors associated with hepatitis A in Nellikuzhy panchayat

Variable	Cases (n=41), n (%)	Controls (n=40), n (%)	<i>P</i>	OR (95% CI)
Gender (male)	39 (95.1)	24 (60)	<0.001	13.00 (2.74-61.58)
Had food from hotel X (yes)	31 (75.6)	1 (2.5)	<0.001	120.00 (14.6-996.2)
Own well at home (yes)	35 (85.4)	36 (90)	0.526	0.65 (0.16-2.49)
Piped water connection (yes)	3 (7.3)	2 (5)	0.665	1.50 (0.23-9.49)
Accessing a public well (yes)	4 (9.85)	4 (10)	0.971	0.97 (0.22-4.18)
Using boiled water for drinking (yes)	27 (65.9)	26 (66.6)	0.939	0.96 (0.38-2.44)
Washing hands after defecation (yes)	36 (87.8)	38 (95)	0.249	0.38 (0.07-2.08)

OR:odds ratio; CI:confidence interval

But, in Kerala with a comparatively better sanitation and hygiene and better standard of living, children often escape infection in early childhood. Ironically, these Improved economic and sanitary conditions led to a higher susceptibility in older age groups and higher disease rates, as infections occur in adolescents and adults, and large outbreaks can occur. The HAV antibody sero prevalence rates reported from Kerala was <10% in children below 5 years when compared to 60–80% from many other parts of the country.^[12-15] These findings along with age distribution of cases during hepatitis A outbreaks in the State suggest that a substantial proportion of individuals in Kerala is not exposed to HAV until adulthood. A mild contamination of water with HAV in such scenario is sufficient to lead to explosive hepatitis A outbreaks. Under favorable conditions, HAV may survive in the environment for months. Person to person spread from asymptomatic and symptomatic cases represents an important transmission mechanism. These findings reiterate the fact that huge outbreaks of hepatitis A have to be expected in the state in coming years.^[7]

There were at least 32 outbreaks of water/food-borne disease outbreaks reported from Kerala alone in 2016 involving 2,421 cases. Many of these outbreaks were due to point sources such as welcome drink distributed during marriage, official ceremonies, juices from hotels, and food distributed during religious rituals and festivals.^[9] Diseases related to contamination of drinking water and food constitute a major burden on public health.^[16-18] Systematic reviews of epidemiological evidence from intervention studies, especially outbreak investigations, suggest that drinking-water quality plays an important role in fecal–oral transmission.^[19-21]

The situation warrants effective food and water safety surveillance, especially during mass gatherings. This particular outbreak investigation is an eye-opener to any such future incidences. Precautionary and mandatory quality and surveillance measures shall be put in place to avoid any such events. Precautionary activities according to the set standards should be done to prevent food-borne outbreaks. The government and its related sectors including health, food safety, water authority, and the public together should play an active role in the provision and consumption of safe drinking water and food.^[22]

“The best way to protect against hepatitis A is by getting the hepatitis A vaccine” says World Health Organisation.^[23] The Centres for Disease Control and Prevention and the Indian Academy of Pediatrics recommend routine vaccination of all children, 12–23 months of age, as well as certain vulnerable populations.^[23] Several studies have demonstrated the immunogenic potential of the hepatitis A vaccine and its excellent efficacy in pre-exposure prophylaxis against HAV.^[24] Many other countries’ experiences have shown that the disease incidence, not only in the vaccinated cohorts but also in the whole population, has decreased within a few years of the start of mass vaccination. There is also convincing evidence that the vaccine confers herd immunity if the main spreaders of the virus are targeted for immunization.^[25]

Person-to-person transmission is the most common way of spread of hepatitis A during an outbreak. A single dose of inactivated vaccine administered to household contacts of hepatitis A cases within 2 weeks of exposure has been found effective in controlling outbreaks and is the policy in many countries.^[26-28] CDC guideline states that “persons who recently have been exposed to HAV and who previously have not received hepatitis A vaccine should be administered a single dose of single-antigen vaccine as soon as possible. For persons aged >40 years, Immuno Globulin is preferred because of the absence of information regarding vaccine performance and the more severe manifestations of hepatitis A in this age group; however vaccine can be used if immuno Globulin cannot be obtained”.^[23]

Primary care clinicians should be aware about the changing epidemiology of hepatitis A in India, affecting older age groups and with increasing fatality. The clinician may also advocate for hepatitis A vaccine based on local epidemiology and cost effectiveness on a one to one basis. Every opportunity should be used to educate the patients and community regarding food safety and methods for prevention of hepatitis A.

The outbreak was investigated as soon as the intimation regarding the outbreak was obtained. There was an obvious failure in the surveillance system to pick up the outbreak earlier. Furthermore, nobody identified the problem in time to do anything about the event that led to the exposure. This investigation was helpful in documenting the missed opportunities for prevention of this outbreak. The investigation helped in eliminating the common source of outbreak, convincing the health workers regarding the need for proper surveillance, the local self-government regarding the importance of sanitary regulations, and proper licensing mechanisms.

The study had several limitations. Attempts for isolating HAV from water samples were not done for want of laboratory infrastructure. Case definition was narrow, and so many mild cases could have been missed. Selection of controls proved tough with age- and gender-matched neighborhood controls, as there were chances of asymptomatic or subclinical presentation of infection. Ideally, serology should have been done to exclude infections among controls. Further investigation has not been conducted to prove the person-to-person transmission. Despite these limitations, the study has public health implications and will add on evidences to the epidemiology of hepatitis A in the state. Well-structured and uniform protocols to monitor the HAV sero prevalence and disease burden are necessary to capture the changing exposure profiles of the population.

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Conflicts of interest

There are no conflicts of interest.

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