Original Research Article

An Outbreak Investigation of Viral Hepatitis E in Siddhpur Town, Patan District, North Gujarat, India

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ABSTRACT

Aims and Objectives: The objectives were: (1) To study the distribution of hepatitis cases, to identify the etiological agent, source of outbreak, and mode of transmission with follow up of cases; (2) To initiate the control measures based on the outbreak investigation.

Material and Methods: The case definition used was: those cases that have/had jaundice with at least one of the following symptoms: Dark urine, fever, pain in abdomen, vomiting, and loss of appetite, elevated serum aminotransferase levels, since June 2014 in Siddhpur urban area. Data were collected through (1) a door-to-door survey and (2) hospital records. Information regarding the date of onset, age, sex, place of residence, treatment, and laboratory investigation was collected from 16 hospitalized patients. The distribution of cases was analyzed using time, place, and person characteristics. Five blood samples were taken for serological survey from jaundice cases for immunoglobulin M (IgM) antibody for hepatitis A virus (HAV) and hepatitis E virus (HEV). We conducted environment investigation to find out the source of contamination of water supply. Water samples were collected to test residual chlorine both from distribution and household level.

Results: Total 8500 individuals were surveyed; of which 130 patients of hepatitis E were identified with the attack rate of 1.53%. The difference in attack rate of hepatitis of both the sexes was statistically significant ($P < 0.001$). The attack rate was significantly higher in age groups >12 years of age ($P < 0.001$). Out of 10 serum samples, 7 were found positive for HEV IgM antibodies. Environmental investigation also confirmed the sewage contamination of drinking water in the distribution system.

Conclusion: The outbreak was due to hepatitis E virus due to contamination of drinking water, valve leakages and inadequate chlorination of water. We recommended a temporary alternative water supply, repair of the leakages, and water quality surveillance with proper chlorination. The recognition of early warning signals, timely investigation, and application of specific control measures can control the future outbreaks.

Key words: Outbreak investigation, Hepatitis E, Attack Rate, Jaundice, Serological Survey

INTRODUCTION

Hepatitis E, formerly known as enterically-transmitted non-A, non-B hepatitis, is an acute, icteric, self-limited disease widely spread in Asia, Africa, Middle East, and Central America. [1-3] The

first documented hepatitis E outbreak occurred in Delhi, India, in 1955–1956. [4] It is an disease that spreads through faecal contamination of drinking water. Acute viral hepatitis is a major public health issue in the developing nations that have inadequate sanitary conditions, inadequate safe drinking water, and sewage disposal problems. [5-7] It occurs both in the form of epidemics as well as sporadic infection in developing countries. [8-11] According to the South East Asia Regional office of the World Health Organization (WHO), hepatitis E is widespread in developing countries, accounting for up to 90 per cent of all sporadic cases of acute viral hepatitis. [12] Hepatitis E virus affects young to middle aged adults and causes high mortality in pregnant women, 20-30 per cent as compared to 0.2-1 per cent in general population. [13] It has been implicated as an important etiological agent for sporadic fulminant hepatic failure (FHF) in developing countries. [14]

Etiology of acute viral hepatitis (AVH) cannot be differentiated on the basis of mode of presentation; confirmation is done serologically. Hepatitis E virus is an important hepatotropic virus that causes acute viral hepatitis. [15] Recognition of early warning signals, timely investigation and application of specific control measures can limit the spread of the outbreak and prevent deaths. [16] Recommendations based on the outbreak investigation also prevent future outbreaks. [7]

An unusual increase of jaundice cases were noticed in Siddhpur town in the middle of June 2014. The health department was informed by UMO (Urban Medical Officer), and a RRT (Rapid Response Team) and district team visited the town immediately on 22/6/201 to identify the causative agent the source of infection and to propose recommendations for future outbreaks prevention.

MATERIALS AND METHODS
Descriptive epidemiology:
An outbreak investigation was carried out at Siddhpur town having population of 62, 000 (Census 2011) on 22/6/2014 by RRT from GMERS Medical College, Patan, Gujarat. The team members were microbiologist, physician, epidemiologist, community physician, pediatrician, laboratory technician and state nodal officer IDSP (Integrated Disease Surveillance Project). There were 9 areas having population of 8,500 affected by this outbreak. We reviewed Jaundice cases in last three months and also in last three years in same months according to IDSP to confirm the outbreak. The case definition used was: those cases that have/had jaundice with at least one of the following symptoms: Dark urine, fever, pain in abdomen, vomiting, and loss of appetite, elevated serum aminotransferase levels, since June 2014 in Siddhpur urban area. Data were collected through (1) a door-to-door survey and (2) hospital records. Information regarding the date of onset, age, sex, place of residence, treatment, and laboratory investigation was collected from 16 hospitalized patients. The distribution of cases was analyzed using time, place, and person characteristics.

Environmental and field investigation:
The RRT visited houses and collected information regarding cases, source of water supply, and drainage system. We also visited 3 main pumping station, sumps and water tanks. Main water supply to the affected area was through Japli pol pumping station. The available blueprint of the water supply pipelines and drains was examined. We checked sanitation around station, chlorination register, making of TCL powder. During affected area visit, we ask about physical drinking water quality door-to-door as perceived by the respondents, food history of the affected persons, and

history of contact with the case of jaundice at home or at work place, IEC activity in the area, and chlorine tablets.

Laboratory methods:

Serum samples of almost all patients were already taken by district authority and sent to reference laboratory at B. J. Medical College, Ahmedabad for HAV IgM and HEV IgM and 5 patients were confirmed having Acute Viral Hepatitis-E. We also taken 5 suspected serum samples and two were confirmed during our field visit of the affected area. Other lab tests like S. Bilirubin (total and direct), and Alanine aminotransferase (ALT) were also done.

Water analysis:

To assess the water quality in the town during the outbreak, Estimation of residual chlorine was performed using Orthotolidine (OT) test at distribution level and from randomly collected consumer levels from common taps and houses in affected area. Three water samples were taken for bacteriology during our field visit of the affected area.

Statistical methods:

Data were entered in Epi-Info 7.0 (CDC, GA, USA, 2011) software version and analyzed. The overall and stratum specific attack rates (with 95% CI) were calculated and compared by chi-square tests.
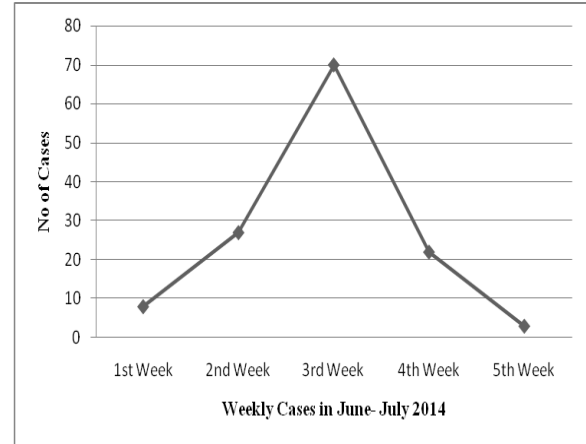
RESULTS

Figure 1: An Epidemic curve of Hepatitis-E in June-July 2014 at Siddhpur, Patan district, Gujarat (n=130)

Table 1 shows line graph of total 130 reported cases of hepatitis E. Outbreak started in middle of June. After 2nd week, cases gradually rise with clustering of cases. In the 3rd week, there was a peak and then a gradual decline in the number of cases was observed. The epidemic curve showed no secondary peaks of incidence.

Table 1: Age and Sex wise distribution of cases in epidemic of Hepatitis-E (n=130)

	Groups	Cases	Populations	Attack Rate (%)	P-value
Age	< 12 years	3	2389	0.13	$\chi^2 = 42.53$, df=1, p<0.01
	> 12 years	127	6111	2.08	
Total		130	8500	1.53	
Sex	Male	89	4737	1.88	$\chi^2 = 8.42$, df=1, p<0.01
	Female	41	3763	1.09	
Total		130	8500	1.53	

Table 1 depicts distribution of cases during outbreak. Majority cases (127) were in >12 years age group and also attack rate is high than <12 years age group. Total 89 (68.5%) are male and average age of males is 28.9 years. Total 41 (31.5%) are females and average age of females is 31.3 years. Attack rate in male is 1.88% which is higher than females which is 1.09%. Overall attack rate is 1.53%. There was no pregnant female involve and death in outbreak. Difference between age and sex distribution was statistically significance at 95% confidence limit.

Clinical manifestations included Jaundice 98.3%, abdominal pain 53%, fever 61.9%, yellow sclera and urine 99%. None

had sign and symptoms of brain involvement. (Table 2)

Table 2: Clinical pictures of patients of Hepatitis-E

Signs and Symptoms	Percentage (%) (Multiple Responses)
Jaundice	98.3
Loss of appetite	77.2
Abdominal Pain	53
Fever	61.9
Nausea and vomiting	69.3
Yellow sclera and urine	99
Malaise	39.7
Headache and Body ache	32
Brain involvement	0

Table 3: Descriptions related to epidemic with last week follow up

Total cases	130
Total deaths	0
Indoor patients up to last week	46
Discharged patients up to last week	41
Under treatment in last week	5
Total serum samples taken	10
Total examined serum samples for HEV*	10
Positive serum samples	7
Water samples for bacteriology	6
Water samples suitable for drinking	2
Water samples not suitable for drinking	4
Water samples tested for residual chlorine	2049
Residual Chlorine Test positive	1849
Residual Chlorine Test negative	200
Total teams assigned for outbreak	6
Medical officer	1
Paramedical staff	8
Total surveyed houses up to last week	5142
Total surveyed population up to last week	29091
ORS given up to last week	206
Chlorine tablets distributed up to last week	65755
Total leakages found	11
Total leakages repaired	11

*HEV=Hepatitis –E virus

Table 3 shows some important description regarding outbreak. There were 130 reported cases with no death. Last week, only 5 patients were under treatment at Siddhpur Civil Hospital. Total 7 patients were confirmed by lab test having Hepatitis E. Up to last week, 6 water samples taken. Out of which, 2 were not suitable for drinking water. Total 200 water samples were negative for residual chlorine. Regarding preventive work, 6 teams were assigned by health authority with medical and paramedical persons. Chlorine tablets and ORS (Oral Rehydration Solution) powder distributed in affected area. During field survey, 11 leakages were found and were repaired by immediate effect.

Table 4: Distribution of the Hepatitis-E cases in families with single or multiple cases (n=130)

No. of cases per family	No. of families	No. of cases	
		Index	New
1	78	78	0
2	11	11	11
3	7	7	14
4	1	1	3
5	1	1	4
Total	98	98	32

Having established that the hepatitis was water borne, we examined whether there was any evidence of intrafamilial (secondary) spread. The number of cases in each family is shown in Table 4. Of 130 hepatitis cases in the sample survey, 78 were the only cases in their family, while of the remaining 52 cases, 20 were "multiple" first cases in the same family. Thus a total of 98 of 130 (75.4%) cases were first cases in their families. All 32 "New" cases occurred after 2 weeks of the onset of clinical disease in the index case.

Table 5: Residual chlorine level during and before outbreak in register at Japli pol, Siddhpur

Dates in Register	Residual Chlorine level
01/04/2014 – 15/04/2014	Not registered
16/04/2014 – 31/05/2014	2 ppm*
01/06/2014 – 17/06/2014	0.2 ppm
18/06/2014	0 ppm
19/06/2014 – Till date	> 2 ppm

*ppm=parts per million

Residual chlorine plays very important role in prevention of any water borne outbreak. Table 5 throws light on that important aspect which was the main lead in this outbreak. Japli pol pumping station was the key which supply the water to the main affected area. Nagarpalika officials were not maintaining the chlorine register before outbreak. Chlorine level was also low at distribution level. Sometime it was only 0.2 ppm. On 18th June, it was 0 ppm. When RRT visited the affected are, it was more

than 2 ppm due to super chlorination done by higher authority orders.

DISCUSSION

It was confirmed that there was an outbreak of Hepatitis-E through lab tests and environmental survey by RRT and local health team. HEV causes a major public health problem in India. Similarly other studies reported HEV as the most important cause of all the clinical types of hepatitis commonly found in India. [16-24]

Total 7 serum samples were found positive for the hepatitis E IgM antibody by ELISA. In other studies also hepatitis E was the major cause of the outbreak. [19,23,24]

Attack rate of acute viral hepatitis ranging from 1.9 to 17% have been reported from various studies from India. [20-26] The overall attack rate in our study was 1.53%, almost comparable with the other study. [21]

The attack rate in males was 1.88% and 1.09% for females and the difference was statistically significant (P < 0.01), higher attack rates in males have also been found in other studies from India. [16, 23, 27]

Population of >12 years showed significantly more number of cases as compared to <12 years of age in this study. The age distribution of HEV cases in this study was similar to previously other studies. [19-21, 24] In developing countries HEV is maintained as sporadic cases in the community and children acquire the infection in early life making them immune to another attack. [19]

Outbreak started in middle of June. After 2nd week, cases gradually rise. In the 3rd week, there was a peak and then a gradual decline in the number of cases was observed. No secondary peak was observed similar finding were reported by various studies. [18,22]

Our analysis of the primary (waterborne) and secondary (intrafamilial) modes of spread of infection was also revealed in some similar studies. [4]

Hepatitis E outbreaks have been reported in urban areas whenever there is a break in the quality of water supplied including water chlorination. [18-23] Many people in the affected area reported turbid water. There were also leakages found in the area. So, clear association was observed between turbid water supply and occurrence of cases of hepatitis in the study. The decreasing of the cases following the extensive repair work carried out by the Nagarpalika further supported our association. Residual chlorine was also found less during the time of and before outbreak investigation through chlorine register.

During outbreak at the onset, safe water supply was made available to the households through water tanks and the people were requested to boil the drinking water till further notice. The people were requested to conduct periodic bacteriological check-up through authority and disinfection of water. The valve mechanism of water tanks was not functioning.11 leakages were also found. The appropriate authority was requested to repair the leaking water pipe line. Sanitation around the pumping station was also very poor. Open air defecation was practicing there and there was a very dirty public latrine nearby which was in closed condition. In another area, river water was directly distributed to the households without any chlorine treatment. As soon as the epidemic was noted (in the middle of June), health workers were deployed to perform active surveillance of the cases and one epidemic medical officer (EMO) was appointed to monitor the activities. Daily reporting of cases and follow up was done to higher health authority. Leakages and repairs in the distribution system and tanks were investigated by the investigation team and a meeting was held with the members of

the Nagarpalika. It took two weeks to complete the entire repair work. Due to active intervention like health education by pamphlets in whole the town, provision for safe water by tanks and chlorination, the outbreak subsided gradually.

CONCLUSIONS AND RECCOMENDATIONS

Based on the above observations, it was concluded that the present outbreak had water borne mode of transmission and the strain of virus responsible was identified as hepatitis E as majority of cases occurred in adolescents and adults which goes in favor of epidemiological age pattern of Hepatitis E. Serological examination also proved Hepatitis E as the cause of current epidemic. The cause of the outbreak was contamination of water during distribution because of leakages valve, inadequate chlorination, staff shortage and irresponsibility by Nagarpalika officials.

We recommended changing old pipelines and valves of water distribution system. Maintain chlorine register and chlorine level at household and distribution level by trained workers. If possible use chlorine gas instead of TCL powder.

The recognition of early warning signals, timely investigation, proper monitoring, and application of specific control measures with sanitation can control the outbreak and decrease morbidity and mortality.

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How to cite this article: Krunal Modi, Jayshri Dund, Rakesh Ninama et. al. An outbreak investigation of viral hepatitis E in Siddhpur town, Patan district, north Gujarat, India. Int J Health Sci Res. 2014;4(10):1-13.

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