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Original Research Article

Epidemiological investigation of an outbreak of viral hepatitis in a defence establishment

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ABSTRACT

Background: An outbreak of viral hepatitis occurred in a defence establishment with 42 cases during November 10 to February 11.
Methods: All suspected cases were clinically assessed according to standard clinical case description, investigated, admitted in hospital till recovery and thereafter sent on sick leave for complete recuperation. Epidemiological investigation included surveillance of data, initiation of epidemiological case sheets, sanitary inspection and environmental investigation of the affected area, bacteriological test of water samples and review of old relevant record.
Results: Point source sewage contamination of water supply was detected at a particular block of a bachelor residential quarter. The outbreak was unimodal, localized, short lasting mostly involving young adults and responded once the control measures were adopted. Suspected water samples showed high coliform count when subjected to bacteriological test.
Conclusions: The outbreak of viral hepatitis occurred due to sewage contamination of water supply. Alternate source of purified water supply, repair of leakages, change of water supply lines and water quality monitoring were recommended.

Keywords: Viral hepatitis, Outbreak, Epidemiological investigation

INTRODUCTION

Enterically transmitted viral hepatitis is endemic in India. Faecal contamination of drinking water is the commonest cause of large outbreaks. Many outbreaks in India have been due to HEV.[1-4] An outbreak of enterically transmitted viral hepatitis occurred among the staff in one of the defence establishments in South India during November 2010 – February 2011 who were residing in a particular unmarried subjects' residential quarter. The study was carried out with the objective to ascertain the principal cause of the outbreak; inter-alia to delineate allied findings if any, and to recommend suitable preventive measures.

METHODS

The study was conducted at a defence establishment in South India during November 2010 to February 2011 where-in 42 cases of viral hepatitis were reported and admitted in the local hospital. Cases were attended and taken up for clinical, laboratory, epidemiological work-up, investigation and surveillance as follow.

Suspected cases

Individuals reporting with complaints of loss of appetite, fever, vomiting, dark colour urine, pain in stomach or yellow discoloration of eyes were considered as

suspected cases and subjected to systematic clinical and laboratory work-up as inpatient till diagnosis was confirmed.

Confirmed cases

Acute illness associated with jaundice, dark urine, loss of appetite, fever, malaise, extreme fatigue and right upper abdominal pain along with increase in serum aspartate & alanine amino transferase (AST and ALT) and bilirubin >2 mg% were taken to establish the clinical diagnosis.[5]

Laboratory investigation

Biochemical parameters such as serum bilirubin, AST, ALT, urine urobilinogen and bilirubin were tested at local service hospital to confirm the diagnosis. All the cases were admitted, observed and followed up for minimum 24 weeks after discharge.

Epidemiological investigation

Elaborate information was recorded in respect of the subjects on date of reporting and posting to the establishment, onset of signs and symptoms, movements on leave/temporary duty and consumption of food from unauthorized sources, if any. Cases were described according to time, place and person.

Environmental survey

A survey was conducted to detect source of water contamination, if any. Sewage leak was observed in the affected building. Blue print of water and sewage line of the locality and the affected area was checked on ground to detect any possible 'cross-contamination'. Place distribution of cases along the water pipe line was mapped (Figure 2: Spot Map). Water samples were subjected to bacteriological examination repeatedly. Data was tabulated, analysed and statistically validated by common statistical applications like incidence rate, test of significance (Chi-Square test) and confidence limits.

RESULTS

The said establishment located in South India, is itself a mini-township having its own water supply and sewage disposal arrangement for the staff and their family members residing in the camp. Water is being provided by the local municipal body; the water is chlorinated and supplied through overhead tank. Sewage is being disposed through underground sewerage finally to sewage treatment plant located 2 km away from the residential area. Camp is otherwise self-sufficient in providing all possible civic facilities including hospital services to the residents.

Table 1: Time distribution of cases according to hospital admission.

Fortnight/month end occurrence	Important dates	Number admitted	Cumulative	Remarks
	21 Nov 10	01	01	Index case
30 Nov 10		02	03	
15 Dec 10		08	11	
31 Dec 10		17	28	
15 Jan 11		10	38	
29 Jan 11		02	40	
	30 Jan 11	01	41	Penultimate case
	01 Feb 11	01	42	Last admission

Table 2: Spatial distribution of cases.

Blocks*	Number of cases	Number exposed	Block specific attack rate(%)	95% CI
A	-	82	-	-
B	04(09.5%)	78	04.25	0.3, 8.20
C	10(23.8%)	110	12.82	5.9. 19.71
D	18(42.9%)	106	16.36	9.31, 23.41
E	05(11.9%)	94	06.09	1.41, 10.77
F	03(07.1%)	72	04.16	0.25, 8.07
G	02(04.8%)	69	02.94	-0.37, 6.25
Total	42(100%)	611	06.80	1.9, 11.7

Chi Sq-25.42, df 5, p<0.001, CI 1.9-11.7, *Blocks A to G – Blocks of bachelor's residence.

Clinical assessment of the patients revealed presence of icterus and dark colored urine in all the 42 (100%) subjects, fever in 41 (97.6%) individuals, loss of appetite in 39 (92.8%) cases, hepatomegaly in 38 (90.5%) and upper abdominal tenderness in 22 (52.4%) patients (Fig 3). S. bilirubin was raised in all the cases with a range of

4.2 to 18.6 mg% having Mean of 6.8 mg%. AST and ALT was raised in all the cases. None of the cases was HbsAg positive.

All cases were admitted to local service hospital. Index case was admitted on 21 November 10 and the last admission was on 01 February 11 (Table 1). There were 03 (7.14%) cases in November 10, 25 (59.52%) in December 10, 13 (30.95%) in January 11 and 1 (2.38%) in February 11 respectively. Maximum number of cases ie.17 (40.48%) reported during 15 to 31 Dec 10. The epidemic curve is homogenous having solitary peak smoothly declining with comparatively less number of cases in the culminating phase of the outbreak (Figure 1).

Table 3: Annual incidence rate during 2005 – 2011.

Year	Number of hepatitis cases	Mid year population	Incidence rate per 1000	95% CI
2005	10	2556	3.91	1.99 - 6.96
2006	8	2616	3.06	1.42 - 5.80
2007	3	2512	1.19	0.30 - 3.25
2008	7	2609	2.68	1.17 - 5.30
2009	6	2684	2.24	0.91 - 4.64
2010*	31[$]	2600	11.92	8.26 -16.67
2011*	18[$$]	2624	6.86	4.20 - 10.61

*Outbreak occurred during Nov- Dec'10 and Jan- Feb'11, [$] 28 cases occurred in Nov & Dec'10, [$$] 14 cases in Jan & Feb'11, Incidence rates for 2010 & 2011 are beyond the 95% CI for the previous 5 years which signify an unusual increase in the Incidence.

Table 4: Water surveillance data July 2010 – February 2011.

Date	Sampling site	Number of samples	Coliform count	Result
9-Jul-10	$A_E - G_E$	7	01-02	Satisfactory
23-Jul-10	$A_W - G_W$	7	01-02	Satisfactory
6-Aug-10	$A_E - G_E$	7	01-02	Satisfactory
20-Aug-10	$A_W - G_W$	7	01-02	Satisfactory
10-Sep-10	$A_E - G_E$	7	01-02	Satisfactory
24-Sep-10	$A_W - G_W$	7	01-02	Satisfactory
8-Oct-10	$A_E - G_E$	7	01-02	Satisfactory
22-Oct-10	$A_W - G_W$	7	01-02	Satisfactory
5-Nov-10	$A_E - G_E$	7	01-02	Satisfactory
19-Nov-10	$A_E - G_E$	7	D_E-10, Rest 01-02	D_E- Unsatisfactory
25-Nov-10	$A_{E/W} - G_{E/W}$	14	D_E-120,Rest 01- 02	D_E- Unsatisfactory
2-Dec-10	$A_{E/W} - G_{E/W}$	14	01-02	Satisfactory
10-Dec-10	$A_E - G_E$	7	01-02	Satisfactory
21-Dec-10	$A_{E/W} - G_{E/W}$	14	01-02	Satisfactory
5-Jan-11	$A_E - G_E$	7	01-02	Satisfactory
14-Jan-11	$A_W - G_W$	7	01-02	Satisfactory
28-Jan-11	$A_E - G_E$	7	01-02	Satisfactory
11-Feb-11	$A_W - G_W$	7	01-02	Satisfactory
24-Feb-11	$A_E - G_E$	7	01-02	Satisfactory

E & W Subscript – Eastern & Western Wings of blocks respectively.

Table 5: Age distribution of cases.

Age Group	No. of cases	No. exposed	Age Specific Attack Rate (%)
17-20	10(23.80%)	172	5.81
21-25	30(71.42%)	334	8.98
Above 25	02(04.76%)	105	1.9

Chi-Sq 6.67, df 2, p-0.036, Significant, $p<0.05$.

Sanitary survey and bacteriological analysis of water samples revealed 'Point Source' contamination at D_E block (D Eastern wing) of a particular unmarried subjects' residential quarter. Existing water pipe lines were laid from A to G alphabetically down the blocks from north to south direction in a main-through-branch supply pattern (Figure 2). Eastern wings of the affected blocks had most of the cases with only exception of D-

west (D_W) which had 03 cases. Supply lines for water were different for Eastern and Western wings. 03 cases in the D_W could have been probably due to their use of water from toilet of D_E block. 42.9% cases were reported in D block followed by 23.8% in C and 11.9% in E respectively. Highest attack rate was seen among the residents of D block followed by C and E (Table 2). A block didn't have any case possibly because of its distant location two blocks prior to point source of contamination. Cases occurred in B and C block apparently because of 'Negative Pressure Suction Effect' taking some of the incriminating agents to supply lines of the said blocks during non-supply hours.

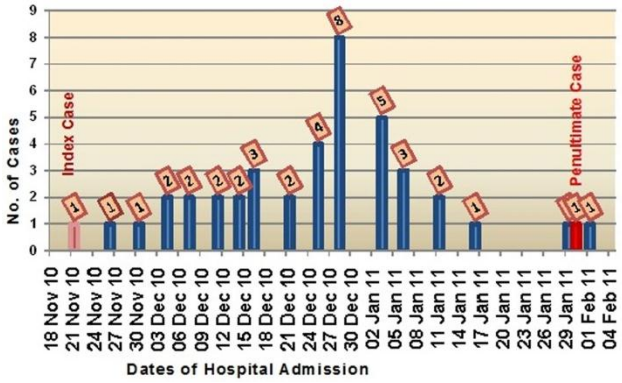

Figure 1: Epidemic curve.

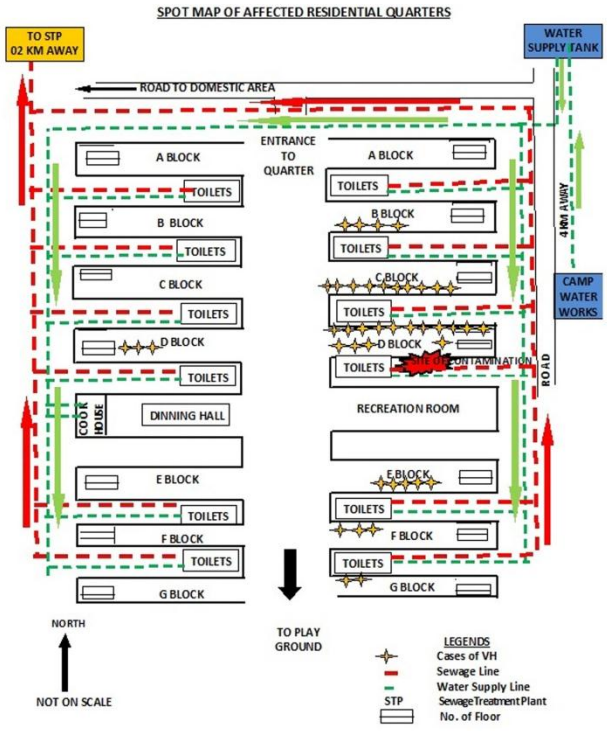

Figure 2: Spot map.

38 (90.50%) stated that they had collected drinking water from the washroom tap in spite of availability of water-cooler with purifier in the next block (Dinning area). 08 (19.04%) gave the history of repeated consumption of food at civil area on holidays. 05 (11.90%) reported of going on outstation leave 30-45 days prior to onset of symptoms; however considering the high number of locally contracted cases, this findings appear to be coincidental. Mean duration of stay in the hospital was 22 days which was followed by 04 weeks sick leave and follow up till 24 weeks.

Epidemiogically 42 cases of Viral Hepatitis occurred among 611 subjects housed in different blocks of a bachelor residential quarter. The Point Incidence rate was 16.15 per 1000 (Total population 2600) which is much higher than the annual incidences of previous years (Table 3). The water pipe line (branch) supplying the wash room complex of D_E block of the said building was old and corroded lying by the side of leaking sewage line. Both the lines were just above the ground adjacent to the washroom complex however, easy visibility was obscured by ample growth of vegetation. Porous and absorbent surrounding soil further made the leakage less noticeable. There was untimely rain due to local weather activity. Neither the residents nor the administrative in-charge of the blocks reported the leak probably because of over-sight and negligence. Residents never noticed any obnoxious smell neither in the tap water nor from the local site. Unusually, there was no increase in incidence of gastroenteritis cases among the local residents prior to the occurrence of the outbreak.

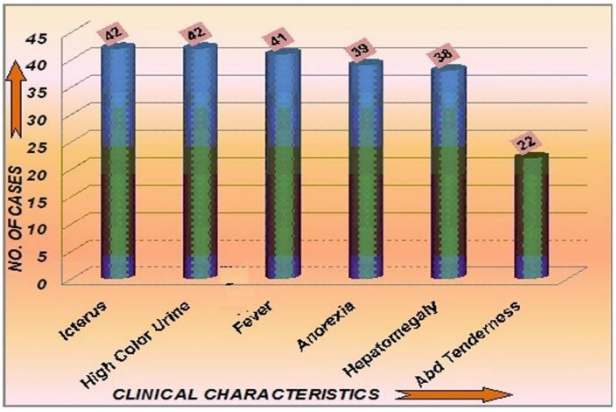

Figure 3: Clinical features.

Serial water sample analysis from the suspected point of contamination (D_E block) showed high presumptive coliform count even up to 120/100 ml in the initial stage(Table 4). The count declined to 02 per 100 ml on 02 Dec 10 after changing of water/sewage lines and cleaning of overhead tanks. However, the water samples from other blocks of the same building didn't reveal any abnormal coliform count. Old records of bacteriological reports of the same and other consumer points were checked and found satisfactory.

Majority (71.42%) of the cases occurred in 21-25 years age group with the highest age specific attack rate (8.98%) followed by 5.81% in 17-20 years group (Table 5). No case of viral hepatitis was reported among the

married subjects, families and even among the single members staying in other bachelor residences during the same time frame. In the year 2010 before the outbreak took place, there were only 3 cases before November 10 among the residents of the establishment. After the outbreak, 04 cases of viral hepatitis occurred among the residents of the establishment in the year 2011; 01 each in May & August 11 and 02 in October 2011 respectively.

DISCUSSION

Faecal contamination of water supply is a frequent finding in the outbreaks of viral hepatitis.[2,6] The apparent association of the present outbreak among those exposed to contaminated water at particular blocks of a bachelor quarter along with high coliform count in suspected water samples of the toilet complex of one of the affected blocks indicates probable sewage contamination of the water supply. This is further strengthened by the fact that cases did not occur among residents of other residential quarters or in the families residing in the married accommodation in the station during the same time frame.

Majority of the cases occurred in the 2nd fortnight of December 2010 followed by 1st fortnight of January 11. The epidemic curve is homogenous and cases cease to occur from 1st February 2011. Preventive measures adopted were successful to contain the epidemic approximately within the time limit of 1 incubation period.

42 cases of Viral Hepatitis occurred among the staff in the defence establishment giving a point incidence of 16.15 per 1000 (Total population-2600). Comparable rate (14.4 per 1000) has been documented in a similar study in an army establishment.[7] Age specific attack rate was highest among 21–25 years age group; this finding is similar to those reported in earlier studies.[8-10] Characteristic of this outbreak was unimodal, localized, short lasting mostly involving young adults. This finding appears commensurate with hepatitis 'E' outbreak, [11] although detection of IgM antibodies against HEV could not be carried out as the facilities for the same was not available locally; which is a limitation in this study. New cases stopped appearing after water contamination was controlled which is further corroborative of HEV as the incriminating agent.[12]

Importance of the study lies in number of trained man-days lost in hospitalization, sick leave, after care and observation for follow up. There were no fatalities possibly because of early prediction and immediate institution of control measures; however long convalescence resulted in low work out put in the respective offices.

The outbreak was due to faecal contamination of drinking water which occurred because of corrosion of old sewage and water pipe lines. It is imperative that the infrastructural and repair works need to be periodically initiated to replace such old pipe lines. Water pipe lines should be laid at least 3 meters horizontally away and 0.3 meter vertically above sewage lines; where such criteria cannot be met, water pipe line may be laid as far apart as possible from sewage lines to prevent contamination.[13] Point of entry of water pipe line and point of exit of sewage lines in toilet complexes may be placed diametrically in opposite direction to avoid cross contamination. Continuing medical surveillance may also be instituted in terms of incidence of excremental diseases, infrastructural deficiencies and chlorination of water including food and water hygiene. Population education on food and water discipline can go a long way in averting such outbreaks. This is a limited study specific to a particular outbreak in a small controlled community and therefore, the result can't be generalized. However, issues deliberated bear importance for any community in the light of health and physical fitness needed for optimum work output and comprehensive productivity especially so, in the premiere organisations like services. It is pertinent to mention that detection of early warning signs, timely investigation and institution of specific control measures could contain the outbreak and prevent mortality.[8]

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Ethical approval: Not required

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