Clinico-epidemiological study of an outbreak of typhoid in North India

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Abstract

Introduction: Typhoid fever is endemic in India. There have been various outbreaks of typhoid fever reported from different parts of India. Considering the outbreak potential of typhoid, the present study was undertaken wherein an outbreak of typhoid occurred in a city in northern India. Methodology: The study design used was a cross-sectional descriptive study. Detailed information was obtained from each reported case. Active case finding surveys were conducted. Case definitions for suspect, probable, and confirmed cases taken for our study, have already been validated by the World health organisation (WHO). All patients were subjected to requisite investigations. A sanitary survey was carried out to locate defects in water supply and sewage disposal. Record of bacteriological survey of water samples from the area was scrutinized. Descriptive epidemiology of cases was carried out. Results: Attack rate was 16.1% and 17.4% among men and women, respectively. Fever was present in 52 (69.3%) cases. The epidemic curve displayed a sudden peak and an abrupt fall of cases. This is suggestive of a common point source outbreak. There were no fatalities. Sanitary survey teams found a sewage leak in the locality where maximum cases were reported. Lab reports tested positive for salmonella species in water. The outbreak was promptly controlled after repair of the leaking sewage pipeline; and provision of alternative source of water supply. Conclusion: This study reemphasises the requirement of a basic public health measure and infrastructure, that is, water quality monitoring by concerned authorities to break the chain of transmission of typhoid fever.

Keywords: Epidemiological, outbreak, typhoid

Introduction

Typhoid fever is a life-threatening epidemic prone disease caused by a gram-negative bacterium, Salmonella Typhi (S. Typhii). Humans are the only natural host and reservoir of the bacterium. Persons with typhoid fever carry the bacteria in their bloodstream and intestinal tract.[1] Lack of sanitation and clean running water cause contamination for long periods of time in resource-poor countries.[2]

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occurred in a mid-sized city in northern India affecting 75 patients from different parts of the city. This study describes the investigation of outbreak of typhoid in Northern India.

**Material and Methods**

The study design used was a cross-sectional descriptive study. It was conducted between Mar 27, 2019 and May 14, 2019 in Khasa semi-urban area of Amritsar city in Northern India. Firstly, verification of the diagnosis was made and then the existence of the outbreak was confirmed which was followed by preparation of detailed epidemiological case sheets to ascertain the cause of the outbreak which included demographic details like age, sex, occupation, address, education status, marital status and then detailed information from each reported case, date of onset of symptoms, date of admission to the hospital, movement history during the incubation period, history of having worked as food handler in any eating establishment, personal hygiene, domestic hygiene, date of last annual medical examination, date of last monthly medication examination, date of last visit to any health facility for any medical help, and other relevant data. Active case finding surveys were conducted among the residents of the city during the period of study. The index case reported on Mar 27, 2019 in medical out patient department (OPD), first case was admitted on Apr 08, 2019 and the last case was admitted on May 14, 2019. The clinical case definition of typhoid fever was step-ladder pattern of fever, headache, rose spots on the trunk, malaise with loss of appetite usually with gastrointestinal symptoms of more than one week duration and having two or more of the following symptoms/ signs; toxic look, relative bradycardia, splenic enlargement, or non-productive cough. A case that met the above criteria was taken as suspect case. A probable case was taken as a case compatible with clinical description and either having Widal test titre of more than or equal to 1:80 or exposure to a confirmed case/carrier/staying in the incriminated barrack during the last three weeks. A confirmed case was a suspected/probable case that was confirmed by positive blood culture for S typhi. The above case definitions have already been validated by Banerjee et al. and WHO.[13,14]

All cases were admitted on clinical suspicion in view of the ongoing outbreak and then subsequently subjected to biochemical tests for confirmation. All patients fulfilling the criteria of confirmed case as well as probable case were included in the study. All admitted patients were subjected to Widal test by tube method. Seventy-five blood cultures were taken. All blood samples for culture and serology were analysed at the laboratory of nearest government hospital where the cases were admitted to confirm the diagnosis. A detailed sanitary survey was carried out in and around the residential area to locate defects in water supply system and sewage disposal. During the survey, visits were made to the houses of the cases by Medical Officer in-charge to scrutinise their food habits, personal as well as domestic hygiene, type of sanitary fittings, type of toilets used, dietary habits, storage practices of cooked/raw food, type of cooking fuel, infestation in kitchen as well as living area and livestock. Besides, the record of bacteriological survey of water samples from the area was also scrutinized and newer samples were taken during the survey which were not part of routine examination. Cases were analysed as per person, place, and time distribution.

**Results**

Index case reported on Mar 27, 2019, and till May 14, 2019, total 75 cases were identified. Clinical symptoms included fever, headache, coated tongue, cough, weakness, chills, and pain abdomen. Attack rate among men was 16.12% whereas in women it was slightly higher, 16.64% Age distribution of cases in presented in Table 1. Sex distribution of cases in tabulated in Table 2. Fever was the most common presentation and was present in 52 (69.33%) cases at some point during the illness, 33 (44%) patients had pain abdomen, and 19 (25.33%) patients had coated tongue. Fever was intermittent with an average duration of 3.53 days (1–8 days). Fever was high grade in 27 (36%) cases [Table 3]. The bar diagram of frequency of clinical features is depicted in Figure 1.

| Table 1: Age distribution of cases |
|----------------------------------|
| Age group | Number of cases (%) |
| <15 years | 22 (29.33) |
| 15–24 years | 17 (22.66) |
| 25–34 years | 27 (36.00) |
| >35 years | 9 (12.00) |
| Total | 75 (100) |

| Table 2: Sex distribution of cases |
|----------------------------------|
| Characteristic | Total cases | Total population | Attack rate |
|----------------|-------------|-----------------|-------------|
| Gender | | | |
| Male | 36 | 2232 | 16.12/1000 |
| Female | 39 | 2343 | 16.64/1000 |
| Total | 75 | 4575 | 16.39/1000 |

| Table 3: Frequency of clinical features |
|----------------------------------------|
| Clinical feature | Number (%) |
|------------------|-------------|
| Fever | 52 (69.33) |
| Headache | 18 (24) |
| Malaise | 13 (17.33) |
| Diarrhea | 21 (28) |
| Constipation | 14 (18.66) |
| Abdominal pain | 33 (44) |
| Rose spots | 12 (16) |
| Hepatomegaly | 0 |
| Splenomegaly | 0 |
| Epistaxis | 1 (1.33) |
| Meningism | 1 (1.33) |
| Coated Tongue | 19 (25.33) |
| Sub-Acute Intestinal obstruction | 1 (1.33) |
Median incubation period was approximately two weeks. On in-depth analysis, it was observed that the epidemic curve displayed a sudden peak followed by an abrupt fall. This is strongly suggestive of a common point source outbreak. This curve does not suggest person-to-person spread. The weekly epidemic curve is depicted in Figure 2.

Rose spots were the most common clinical sign present in 12 (16%) patients, with six (8%) cases presenting it without any history of fever. These cases were diagnosed on the basis of positivity of Typhi Dot test. Epistaxis, meningism, and subacute intestinal obstruction (SAIO) were seen in one patient each. There were no complications or fatalities.

Case distribution, according to place and sex, is presented in Figure 3. Schematic spot map of the various areas from where the cases were reported is depicted in Figure 4.

Sanitary survey was carried out in detail by two independent teams. One team comprised a Medical Officer and a paramedic who were providing medical cover in the nearest government dispensary. The second team included one Community Medicine specialist from the local health department and the health assistants. Both teams found a sewage leak in the locality where maximum number of cases had been reported. Water samples from water pipeline, water tank supplying the locality and taps of randomly selected houses were taken for the bacteriological survey. Lab reports tested positive for salmonella species in water, after which sewage pipeline exploration by digging was carried out on Apr 16, 2019 as per the blueprint of the water supply and sewage system available with the public health engineering department. The exploration revealed massive leakage of sewage pipeline and water pipeline in close proximity to each other. The water and sewage pipelines were totally corroded and leaking at several places along the blueprint. The outbreak was promptly controlled after detection of these leaking pipelines, repair of the leaking sewage pipeline, and provision of alternative source of water supply to the affected area.

Discussion

In the present outbreak, higher attack rates of typhoid were found in those, consuming water supplied from the leaking water pipelines passing adjacent to sewage pipeline, than in those who consumed water supplied from other pipelines indicating that the present outbreak was due to sewage contamination of drinking water supply. This finding is also confirmed by the presence of high coliform counts in drinking water at the consumer end just after the onset of the outbreak.

Typhoid epidemics are frequently unimodal and short-lasting owing to urgent and emergent interventions. Some have been multimodal, suggesting a delay in control of water contamination, and other necessary public health intervention. Typhoid outbreaks are frequently caused by contamination of water supply systems. Young adults in the age group of 15 to 40 years are commonly affected by typhoid as is seen in this study.

There has been a decline in isolation of Typhi in the past five years, on account of female literacy, economic improvement and empirical use of antibiotics. India is endemic to typhoid with temporal outbreaks as brought out by this study being reported from various other countries. In 2002, a total of 5963 cases of typhoid fever were recorded in Bharatpur, Nepal (population, 92,214) during a seven-week period. Further investigation revealed large, explosive single-point source outbreak through contaminated water.[13] and in 2008–2009, a typhoid outbreak in Uganda was detected because of increased reporting of cases of Intestinal Perforation due to underreporting of milder illnesses and delayed and inadequate antimicrobial treatment.[16]
Researchers from New Delhi, India, reported that S. Typhi (75.7%) was the predominant serovar isolated during the study period followed by S. Para typhi A (23.8%). The maximum number of enteric fever cases occurred during April to June (dry season) followed by July to September, that is monsoon season.\(^4\)

Ciprofloxacin for adults, excluding pregnant women, is presently the treatment of choice. There is a dramatic increase in nalidixic acid-resistant isolates with reduced susceptibility to fluoroquinolones, although all isolates are susceptible to third-generation cephalosporins. Patients infected with such strains may not be responsive to treatment with ciprofloxacin, which could lead to reports of treatment failure cases.\(^5\)

Although mortality has been frequently associated with many outbreaks but in contrast no mortality has been observed in our study. This difference in mortality can be attributed to prompt and energetic institution of preventive measures which were implemented to contain the outbreak. Extensive health education regarding the mode of spread, prevention, and clinical presentation of typhoid was given at ward level as well as at the family/community level. All health assistants were instructed to actively look for cases with fever, malaise, diarrhoea, constipation, abdominal pain, and bring them to medical attention at the earliest. Furthermore, strict preventive measures in chlorination of water, prophylaxis for contacts as well as high risk cases was done. Several outbreak investigations studies have been done in India where few studies are multifactorial, while most of them are concluding contaminated water to be the source of outbreak and clean water and hygienic measures had been proven to be effective.\(^3,4,8-12,17\)

### Conclusion

The present study provides strong evidence of how typhoid outbreaks continue to occur whether in the past or in the present modern world, whether in developing nations like India or in the developed world due to contamination of drinking water. This study thus reemphasises the requirement of a basic public health measure and infrastructure, that is, water quality monitoring by concerned authorities to break the chain of transmission of enteric fever and other waterborne diseases.

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### Conflicts of interest

There are no conflicts of interest.

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