

## Original Research Article

# Epidemiological characteristics of acute dehydrating diarrhea during an epidemic of cholera: a study from North India

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## ABSTRACT

**Background:** Cholera is an acute diarrheal disease which continues to be a public health problem since inception. It is a disease related to poverty, overcrowding, poor sanitation and inaccessibility to clean water. India forms a fertile ground for the sustenance and transmission of cholera. However the diagnosis of cholera doesn't easily come to mind when dealing with cases of dehydrating diarrheas.

**Methods** The study was a prospective cohort study conducted in a tertiary care center of North India. All patients presenting to the medicine department of this hospital with acute dehydrating diarrhea were enrolled for the study. Stool samples for hanging drop test and culture were sent in all patients to rule this cholera.

**Results:** Eighty four patients presenting to the medicine department of this hospital with acute dehydrating diarrhea were included in this study. All the patients had loose watery stools but classical rice water stools were seen in only 20.2% of patients. Patients with rice water stools were more likely to be positive for stool culture (70.6%, n = 12/17) and hanging drop preparations (82.3%, n = 14/17) as compared to those with watery stools. The difference was found to be statistically significant for culture (70.6% vs 40.3%, p-value = 0.02) as well as hanging drop preparation (82.3% vs 47.8%, p-value = 0.01).

**Conclusions:** The prevalence of culture positive cholera cases was found to be 46.4% out of all the cases presenting with acute dehydrating diarrhea which is quite high. Rice water stools which are considered characteristic for cholera were found in less than half of culture positive cases of cholera (43.6%, n = 17/39). Hanging drop preparation was found to have a sensitivity of 87.2% and a specificity of 86.5% in comparison to stool culture which is regarded as gold standard for diagnosis of cholera. Cholera may be considered as an ongoing epidemic with periodic surge in cases and should be suspected whenever cases of acute watery diarrhea present in increased numbers with features of severe dehydration, especially when the cases are clustered together and from a poor socio-economic background.

**Keywords:** Cholera, Epidemic, Hanging drop preparation, Rice water stools

## INTRODUCTION

Cholera is an acute diarrheal disease caused by ingestion of food or water contaminated by bacterium *Vibrio cholera* and can be lethal within hours if untreated. With descriptions dating back to antiquity, cholera continues to

remain a public health problem not just in developing countries but the entire world, with seven reported pandemics since 1817.<sup>1</sup> The seven pandemics of 1817, 1829, 1852, 1863, 1881, 1889 and 1961 marked the global spread of cholera beyond Asia, often regarded as the ancestral home to cholera.<sup>2</sup> While the first six pandemics were caused by the classical biotype of *Vibrio*

cholera, the last one was caused by El tor biotype and is believed to be an ongoing pandemic.<sup>3</sup>

Cholera transmission is linked closely to overcrowding, poverty, poor sanitation and inaccessibility to clean water, with areas like slums and refugee camps being at highest risk. The disruption of these facilities is maximized in humanitarian crisis like wars, floods, earthquakes, etc which harvest circumstances conducive for the spread of cholera. With more than 20% of the population living below the official poverty limit, India forms a fertile ground for transmission and sustenance of cholera.<sup>4</sup>

Owing to logistic precincts, social, political and economic deterrents, cholera goes vastly unreported. The most striking example of this can be found in the WHO cholera epidemiological record of 2009 wherein India and Bangladesh reported no case of cholera, despite anecdotal evidence pointing to contrary.<sup>5</sup> Nevertheless, conservative estimates place global burden of the disease at around 1.3 to 4.0 million cases annually with an estimated mortality of 21,000 to 1,43,000 per year.<sup>6</sup>

The idea for this study was serendipitously inoculated during an acute surge of diarrheal disease in this tertiary care hospital. In the month of September 2019, a surge was seen in cases of acute diarrhea presenting to the medicine department of this hospital. There was no other significant complaint like abdominal pain, tenesmus, fever, etc and all the patients were hemodynamically stable. All the patients were discharged with advice regarding hydration and symptomatic treatment. Some of the patients had to be given intravenous fluids following adamant request, mostly for psychological well-being and placebo effect. In the month of October-November (study period), cases of acute diarrhea increased and some of them were critical at the time of admission with features of shock. These patients had a pattern of a short duration of diarrhea which deteriorated the patient to a state of shock within a span of 2-3 hours. All these patients were resuscitated and managed with aggressive fluid therapy. The stool was collected for observation in these patients and a diagnosis of cholera suspected based on the classical rice water appearance (Figure 1).



**Figure 1: Rice water stools.**

Following this observation, all patients who presented with acute diarrhea to the medicine department of this hospital over a period of one month were admitted and evaluated for cholera. The purpose of this study was to assess the epidemiological characteristics of cholera during the outbreak of an epidemic indicated by the abrupt surge of cases witnessed.

## METHODS

The study was a prospective cohort study conducted in this tertiary care hospital of Haryana, North India. Institutional ethical committee clearance was obtained prior to conducting this study. All patients presenting to medicine department of this hospital with complaints of acute dehydrating diarrhea were enrolled for the study after obtaining an informed consent. All patients presenting with diarrhea were assessed for features of dehydration like thirst, dry tongue, decreased salivation, decreased skin turgor, sunken eyes, rapid feeble pulse, decreased urine output, increased capillary refill time, postural hypotension, hypotension and shock and were classified into mild moderate or severe dehydration based on POAC (primary option for acute care) guidelines.<sup>7</sup> All patients with acute dehydrating diarrhea had their stool sample collected for hanging drop preparation for darting motility characteristic of *Vibrio cholera* (Figure 2).



**Figure 2: Hanging drop preparation of stools.**

Stool samples were also sent for culture of *Vibrio cholera* on thiosulfate-citrate-bile salt (TCBS) agar incubated at 37°C for 16-20 hours. Stool specimen for culture was transported in Venkataraman-ramakrishnan (VR) medium as the bacterium remains viable in this medium for long durations making transportation to laboratory feasible.<sup>8</sup> The detailed demographic data, clinical history and examination and relevant investigations of these patients were compiled in the form of a master chart and subjected to statistical analysis.

## RESULTS

Eighty four patients presenting to the medicine department of this hospital with acute dehydrating diarrhea were included in this study. The age of the

patients ranged from 14 to 46 years with a mean age of 24.6 years. The demographic data of patients is presented in Table 1.

**Table 1: Patient demographics, clinical and laboratory characteristics.**

Demographics	Number	Percentage
<b>Age group</b>		
14-20 years	14	16.7%
21-30 years	34	40.5%
31-40 years	24	28.5%
41-50 years	12	14.3%
<b>Gender</b>		
Male	54	64.3%
Female	30	35.7%
<b>Occupation</b>		
Labourers	32	38.1%
Semi-skilled worker	16	19.1%
Unemployed/children	23	27.4%
Shopkeeper	8	9.5%
Fruitseller	5	5.9%
<b>Socioeconomic status</b>		
Lower	40	47.6%
Upper lower	28	33.3%
Lower middle	12	14.3%
Upper middle	4	4.8%
Upper	0	0
<b>Fever</b>		
Yes	15	17.9%
No	69	82.1%
<b>Vomiting</b>		
Yes	22	26.2%
No	62	73.8%
<b>Abdominal pain</b>		
Yes	26	30.9%
No	58	69.1%
<b>Dehydration</b>		
Mild	49	58.3%
Moderate	20	23.8%
Severe	15	17.9%
<b>Rice water stools</b>		
Yes	17	20.2%
No	67	79.8%
<b>Hanging drop test</b>		
Positive	46	54.8%
Negative	38	45.2%
<b>Stool culture</b>		
Positive	39	46.4%
Negative	45	53.6%

The median duration of diarrhea at the time of presentation was 18 hours (range: 1-102 hours) and mean stool frequency was 1.8 stools per hour (range: 1-5). All the patients had loose watery stools but classical rice water stools were seen in only 20.2% of patients.

Patients with rice water stools were more likely to be positive for stool culture (70.6%, n = 12/17) and hanging drop preparations (82.3%, n = 14/17) as compared to those with watery stools. The difference was found to be statistically significant for culture (70.6% vs 40.3%, p-value = 0.02) as well as hanging drop preparation (82.3% vs 47.8%, p-value = 0.01).

Hanging drop and culture positivity was correlated with the extent of dehydration. Proportion of patients with positive hanging drop preparation was higher in case of patients with severe dehydration (80%, n = 12/15) as compared to those with moderate (60%, n = 12/20) or mild (44.9%, n = 22/49) dehydration. The difference was found to be statistically significant with a p-value of 0.049. Similarly, higher percentage of patients with stool culture positivity was seen in patients with severe dehydration (73.3%, n = 11/15) as compared to moderate (40%, n = 8/20) or mild (36.7%, n = 18/49) dehydration and the difference was again found to be statistically significant with a p-value of 0.04. Patients with a positive hanging drop test were significantly (p-value = 0.003) more likely to test positive for stool culture (60.9%, n = 28/46) as compared to those with a negative test (28.9%, n = 11/38).

## DISCUSSION

The prevalence of culture positive cholera cases was found to be 46.4% out of all the cases presenting with acute dehydrating diarrhea which is quite high. Although there are no national guidelines regarding testing for cholera in routine cases of diarrhea, the present study points towards a need for the same especially at times of surge in cases of diarrhea which may be pointer towards an epidemic. Rice water stools which are considered characteristic for cholera were found in less than half of culture positive cases of cholera (43.6%, n = 17/39). This points to the fact that rice water stools cannot be used as a screening tool for cholera. These findings were similar to those reported by Kuttia et al, who didn't find rice water stools to be a sensitive or specific pointer towards a diagnosis of cholera.<sup>8</sup>

Majority of this patients belonged to the lower class of the modified Kuppaswamy scale. Authors found cholera to be predominantly a disorder affecting the poor and impoverished. Most of these patients were unskilled labourers and semi-skilled workers living hand to mouth. Living conditions were not satisfactory with lack of adequate sanitation and access to clean water.

Overcrowding was also a factor which contributed to outbreaks of this disease especially in families. This was consistent with other studies conducted in the past which have found these conditions to predispose to the outbreaks of cholera.<sup>9-11</sup>

Hanging drop preparation was found to have a sensitivity of 87.2% and a specificity of 86.5% in comparison to

stool culture which is regarded as gold standard for diagnosis of cholera.<sup>12</sup> This findings were comparable to those reported by Kuttiat et al, although some studies in the past have reported lower sensitivity for hanging drop test.<sup>13</sup>

It is an inexpensive test which can be helpful in resource poor settings and in cases of epidemic where specialized laboratories and trained personnel may not be available for performing stool culture.

Cholera is known to cause severe acute dehydrating diarrhea. The diarrhea may lead to severe dehydration resulting in rapid deterioration in the clinical status and patient may land in shock. Rapid diagnosis of epicenters and foci of cases can help in containing an epidemic. Cheap, rapid and easily available tests like hanging drop preparations can contribute a great deal in this regard. The present study documented a sudden and unexpected increase in the number of cholera cases thus pointing to a potential epidemic which, however, remained contained to the affected groups of families and didn't spread further. Cholera may be considered as an ongoing epidemic with periodic surge in cases and should be suspected whenever cases of acute watery diarrhea present in increased numbers with features of severe dehydration, especially when the cases are clustered together and from a poor socio-economic background.

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