ORIGINAL ARTICLE

# Acute bacterial gastroenteritis: a study of adult patients with positive stool cultures treated in the emergency department

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**Objectives:** To investigate the presenting clinical features of acute bacterial gastroenteritis in adult patients treated as outpatients in the emergency department (ED), and the pathogens responsible in this setting and population; and to identify the frequency with which positive stool culture result changes management.

**Method:** This was a retrospective study of all patients who attended the accident and emergency department of an university affiliated hospital in Hong Kong over a 12 month period, who satisfied the following inclusion criteria: (a) age ⩾16, (b) presented with acute gastroenteritis, (c) treated as outpatients with or without observation, and (d) had positive stool cultures.

**Results:** One hundred and thirty patients were included. Pathogens identified were *Vibrio parahaemolyticus* (42.3%), *Samonella spp* (34.6%), *Plesiomonas spp* (9.2%), *Campylobacter spp* (6.9%), *Aeromonas spp* (6.9%), and *Shigella spp* (6.2%). Mean highest body temperature was 37.5°C (95% confidence intervals (CI) 37.3 to 37.6). Bloody diarrhoea was present in 14 patients (10.8%). Mean duration of diarrhoea, from onset to the completion of stay in ED, was 2.2 days (95% CI 1.7 to 2.7). Likewise, mean duration of abdominal pain was 1.8 days (95% CI 1.5 to 2.1). Mean number of unformed stools per day was 9.3 (95% CI 8.3 to 10.3). Change of management, subsequent to the availability of positive stool culture results, was not required in 115 (88.5%) patients. Ciprofloxacin resistance occurred in eight (6.2%) cases, and seven of nine campylobacter isolates. Campylobacter positive patients had a significantly longer duration of abdominal pain (p=0.0236) and were less likely to be dehydrated (p=0.0103).

**Conclusions:** Most patients with bacterial gastroenteritis do not present with high fever, bloody diarrhoea, or persistent diarrhoea, but generally have quite severe diarrhoea. Stool cultures do not change management for most patients. *Vibrio parahaemolyticus* is the commonest bacterial pathogen identified.

Patients with acute gastroenteritis commonly present to emergency departments (EDs) and primary care facilities worldwide. Aetiological agents can be viral, bacterial, or protozoan; and bacterial agents can be either enteropathogenic, toxigenic, or both. The guidelines of the American College of Gastroenterology recommend that stool cultures in adults are indicated in the presence of severe diarrhoea, a temperature ⩾38.5°C (orally), passage of bloody stools, or persistent diarrhoea.[1] Most cases of acute infectious diarrhoea caused by bacterial enteric pathogens are self limiting. The main goals in management are symptomatic treatment, rehydration or prevention of dehydration, prevention of spread of infection, and empiric antibiotic treatment in selected cases.[2 3] Most practitioners believe that by the time stool culture results are available, the impact on practical treatment of individual patients is most often minimal. However, to date, this has not been formally studied and quantified in indexed literature. Therefore, the aims of this study are:

1 To investigate the presenting clinical features of acute bacterial gastroenteritis in adult patients treated as outpatients in the ED, and the range of pathogens responsible for this specific study population and setting; and

2 To examine the frequency with which positive stool culture results lead to a change in clinical management.

An attempt is also made to correlate clinical features of patients at presentation with the organism group identified from stool cultures.

## METHODS

A retrospective review was performed. The setting was the accident and emergency department of a 1400 bed university affiliated major hospital in Hong Kong, with an annual ED patient attendance of 190 000. All positive stool cultures requested by the medical officers of the ED and performed between 1 January 1999 and 31 December 1999 were identified, and the corresponding clinical records traced. The inclusion criteria for the study were: patient's age ⩾16, presentation to the ED with symptoms of acute gastroenteritis, and treated as outpatients with or without a period of observation in the short stay observation unit of the ED. Demographic features (for example, age, sex, date of presentation, and history of recent travel); clinical features (body temperature, passage of bloody stools, severity of diarrhoea, and the duration of diarrhoea, abdominal pain, and vomiting respectively); and laboratory record of the specific pathogens identified were entered into a database. Descriptive statistics was generated. Data describing the presenting clinical features of each patient were recorded according to the definitions listed in the box.

Stool samples were investigated for the presence of *Salmonella, Shigella, Campylobacter,* and *Vibrio spp* according to standard laboratory procedures,[4] followed by antibiotic susceptibility testing. *Aeromonas* and *Plesiomonas* were occasionally found during the routine search for *Salmonella* and *Shigella*. The turnaround time for negative result reporting was three days while that of positive reports was three to five days.

For every patient with positive stool pathogens identified, a reassessment of their clinical condition, either by telephone

**Definition of clinical parameters obtained from retrospective record review**

**Highest body temperature**
The highest oral temperature recorded during attendance in ED or observation unit stay.

**Bloody diarrhoea**
Either suspected by history from patient, or confirmed by inspection of stool, and not attributable to local anorectal bleeding.

**Duration of diarrhoea (days)**
The duration of diarrhoea from onset to the completion of stay in ED or observation unit. (0–24 hours =1 day; 24–48 hours =2 days, etc)

**Number of unformed stools a day**
Can be by history (maximum number per day) on presentation, or recorded in observation unit charts, whichever is larger in number.

**Duration of abdominal pain (days)**
The duration of abdominal pain from onset to the completion of stay in ED or observation unit. (0–24 hours =1 day; 24–48 hours =2 days, etc)

**Duration of vomiting (days)**
The duration of vomiting from onset to the completion of stay in ED or observation unit. (0–24 hours =1 day; 24–48 hours =2 days, etc)

**Dehydration/intravenous fluid**
Dehydration or poor oral intake requiring intravenous fluid.

contact or follow up visit, was arranged according to departmental policy. Any change in management would then be recorded in the case notes. This study looked retrospectively in order to identify every case in which management was subsequently changed (for example, institution or change of antibiotics) in the light of a positive stool culture result. We also investigated whether empiric antibiotic treatment, intravenous fluid therapy, or observation unit admission were required by each patient, and whether the request for stool culture had been in compliance to the guidelines of the American College of Gastroenterology. The guidelines recommend that stool cultures be obtained in the presence of severe diarrhoea (≥6 times in a 24 hour period), a temperature ≥38.5°C (orally), passage of bloody stools, or persistent diarrhoea (≥3 days).[1] At the time of the study, no policy was in place in our department as to which patients should have stool culture investigation.

Statistical comparisons were performed with Statview (Abacus concepts) version 5.0 using Fisher's exact and Mann-Whitney U tests as appropriate.

## RESULTS

One hundred and thirty patients met inclusion criteria over the 12 month period. Demographic and clinical features, according to pathogens identified, are shown in tables 1 and 2. In eight cases, more than one organisms were isolated from the stool sample. The mean age was 42 years (95% confidence intervals (CI) 39 to 45), and 68 (52.3%) were female. Twenty (15.3%) patients had highest body temperature ≥38.5°C; 27 (20.8%) patients had duration of diarrhoea ≥3 days; and 86 (66.2%) patients had number of loose stools ≥6/day. The request for stool cultures was found to be compliant to the guidelines of the American College of Gastroenterology in 109 (83.8%) cases.

In nine patients, the clinical management was changed after the stool culture result was available (for example, start of or change of antibiotic treatment). Management remained unchanged in 115 (88.5%) patients. The data for the remaining six (4.6%) patients were indeterminate in this respect because of incomplete records. Three patients (2.3%) required subsequent hospitalisation for management, because of persistent symptoms. The number of negative stool cultures of ED patients, age ≥16, over the corresponding period, was 524.

Salmonella positive patients, when compared with non-salmonella patients, were found to have a significantly higher mean highest body temperature (37.86 *v* 37.21; mean difference 0.64 (95% CI 0.28 to 1.00); p=0.0022); and they also had a significantly longer mean duration of abdominal pain at presentation to the ED (2.2 *v* 1.5 days; mean difference 0.75 (95% CI 0.05 to 1.45); p<0.0001).

Campylobacter positive patients, when compared with non-campylobacter patients, were significantly less likely to be dehydrated, to require intravenous fluid therapy, or observation; but were more likely to require change of management subsequent to the availability of stool culture results (table 3). Their mean duration of abdominal pain at presentation to the ED was significantly longer (3.6 *v* 1.4 days; mean difference 2.0 (95% CI 0.76 to 3.25); p=0.0236). They have fewer loose stools a day (mean, 5.8 *v* 9.4; mean difference 3.6 (95% CI 0.7 to 7.9); p=0.0651).

**Table 1** Demographic features and processes of care of patients with positive stool culture, according to pathogens isolated

| Demographic features/processes of care | Positive cultures (Total) | Salmonella | *Vibrio parahaemolyticus* | Campylobacter | Shigella | Plesiomonas | Aeromonas |
|---|---|---|---|---|---|---|---|
| Number (% of total) | 130 | 45 (34.6) | 55 (42.3) | 9 (6.9) | 8 (6.2) | 12 (9.2) | 9 (6.9) |
| Mean age (y) | 42 | 46 | 40 | 36 | 37 | 47 | 43 |
| 95% confidence intervals | 39 to 45 | 39 to 51 | 36 to 44 | 21 to 51 | 22 to 52 | 32 to 62 | 32 to 54 |
| Female (%) | 52.3 | 57.7 | 47.2 | 44.4 | 37.5 | 41.6 | 77.7 |
| Observation unit utilisation | 63 | 27 | 24 | 1 | 4 | 7 | 5 |
| data availability (%) | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Empiric antibiotics given | 20 | 9 | 6 | 1 | 4 | 1 | 1 |
| data availability (%) | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Stool request in compliance to guidelines | 109 | 38 | 49 | 8 | 7 | 9 | 7 |
| data availability (%) | 95.3 | 100 | 98.2 | 88.9 | 100 | 83.3 | 88.9 |
| Management changed by stool culture results | 9 | 4 | 2 | 3 | 0 | 0 | 0 |
| data availability (%) | 95.3 | 95.6 | 100 | 88.9 | 97.1 | 100 | 77.8 |

**Table 2** Clinical features of patients with positive stool culture, according to pathogens isolated

| Clinical features | Positive cultures (Total) | Salmonella | *Vibrio parahaemolyticus* | Campylobacter | Shigella | Plesiomonas | Aeromonas |
|---|---|---|---|---|---|---|---|
| Mean highest body temperature (°C) | 37.47 | 37.86 | 37.3 | 36.96 | 37.6 | 37.14 | 37.44 |
| 95% confidence intervals | 37.30 to 37.64 | 37.52 to 38.20 | 36.06 to 37.54 | 36.25 to 37.77 | 36.98 to 38.22 | 36.66 to 37.62 | 36.88 to 38.0 |
| data availability (%) | 93.8 | 95.6 | 94.5 | 88.9 | 100 | 91.7 | 88.9 |
| Bloody diarrhoea | 14 | 1 | 4 | 3 | 4 | 0 | 2 |
| data availability (%) | 100 | 100 | 100 | 100 | 100 | 100 | 100 |
| Mean duration of diarrhoea (days) | 2.2 | 2.9 | 1.4 | 2.8 | 1.9 | 1.6 | 3.1 |
| 95% confidence intervals | 1.7 to 2.7 | 2.0 to 3.8 | 0.9 to 1.9 | 1.9 to 3.7 | 0.8 to 3.0 | 0.4 to 2.8 | 0 to 6.3 |
| data availability (%) | 97.7 | 100 | 98.2 | 88.9 | 100 | 91.7 | 100 |
| Mean number of unformed stools per day | 9.3 | 8.4 | 10 | 5.9 | 10.7 | 9.8 | 8.6 |
| 95% confidence intervals | 8.3 to 10.3 | 6.8 to 10.0 | 8.4 to 11.6 | 3.5 to 8.3 | 4.1 to 17.3 | 5.4 to 14.2 | 4.0 to 13.2 |
| data availability (%) | 90.0 | 88.9 | 96.4 | 77.7 | 97.1 | 83.3 | 88.9 |
| Mean duration of abdominal pain (days) | 1.8 | 2.3 | 1.1 | 3.7 | 2.3 | 1.2 | 2.2 |
| 95% confidence intervals | 1.5 to 2.1 | 1.7 to 2.9 | 0.8 to 1.4 | 0.6 to 6.8 | 0.6 to 4.0 | 0.5 to 1.9 | 0.5 to 3.9 |
| data availability (%) | 96.9 | 95.6 | 98.2 | 100 | 100 | 91.7 | 100 |
| Mean duration of vomiting (days) | 0.6 | 0.9 | 0.6 | 0.2 | 0.4 | 0.4 | 0.4 |
| 95% confidence intervals | 0.4 to 0.8 | 0.4 to 1.4 | 0.5 to 0.7 | 0 to 0.5 | 0 to 1.0 | 0.1 to 0.7 | 0 to 0.8 |
| data availability (%) | 98.5 | 100 | 98.2 | 100 | 100 | 91.7 | 100 |
| Dehydration/intravenous fluid | 54 | 23 | 21 | 0 | 5 | 6 | 4 |
| data availbility (%) | 100 | 100 | 100 | 100 | 100 | 100 | 100 |

Shigella positive patients, compared with non-shigella patients, were more likely to have bloody diarrhoea (p=0.0047), and were more likely to be given empiric antibiotic treatment (p=0.0194).

*V parahaemolyticus* patients, compared with non-*V parahaemolyticus* patients, presented to the ED with a significantly shorter mean duration of diarrhoea (1.4 *v* 2.6 days; mean difference 1.3 (95% CI 0.4 to 2.2); p<0.0001).

Regarding susceptibility to ciprofloxacin, eight (6.2%) stool samples were resistant, two were intermediately sensitive, and 120 (92.3%) were sensitive. Seven of nine campylobacter positive samples were resistant to ciprofloxacin; and all campylobacter isolates were sensitive to erythromycin.

## DISCUSSION

The American College of Gastroenterology emphasised that its guidelines on the indications for stool cultures were intended to be flexible, and should be distinguished from standards of care.[1] The recommendation was based primarily on three references.[5–7] In comparison, this study's findings are that, for an adult patient treated in the ED with bacterial gastroenteritis, the mean highest body temperature was 37.47°C, the average number of unformed stools at presentation was 9.3 per day, the mean duration of diarrhoea from onset of illness to discharge from ED was 2.2 days, and only 10.8% had bloody diarrhoea. The practice guidelines for the management of infectious diarrhoea,[8] published recently by the Infectious Diseases Society of America (IDSA), also have not exactly defined what constitutes high temperature or severe diarrhoea, for which stool culture studies are indicated. Further randomised controlled studies with multivariate analyses are needed to delineate what are the best predictors of positive stool cultures in this setting.

**Table 3** Comparison of campylobacter with non-campylobacter stool culture positive patients in relation to (1) dehydration or intravenous fluid therapy requirement, (2) observation unit utilisation, and (C) the need for a change in management subsequent to stool culture result

| | Campylobacter | Non-campylobacter | p Value |
|---|---|---|---|
| Dehydration or intravenous fluid required (number) | | | |
| Yes | 0 | 54 | 0.0103 |
| No | 9 | 67 | |
| Observation unit used (number) | | | |
| Yes | 1 | 62 | 0.0335 |
| No | 8 | 59 | |
| Management changed (number) | | | |
| Yes | 3 | 6 | 0.0125 |
| No | 5 | 110 | |

How important is it in clinical practice, when treating a patient with acute gastroenteritis, to identify the responsible pathogen? Gastroenteritis is most often a self limiting disease, and most authorities are of the opinion that stool cultures should be restricted to patients who are severely dehydrated, toxic, or immunocompromised.[3 9] The mainstay of treatment is to maintain hydration, relieve symptoms, prevent spread of infection, and to give antibiotics empirically for indicated cases. For most of the commonly encountered pathogens, specific antibiotic treatment is not needed if symptoms have improved by the time that culture results become available.[2 3] In our study in which 83.8% stool cultures were requested in compliance to the American College of Gastroenterology guidelines, 88.5% patients had recovered by the time that culture positive results were available, and such that no change of treatment in terms of antimicrobial treatment was required. This finding shows that stool cultures have only a limited impact in patient management for most patients. However, it is important to note that negative studies for potential pathogens also have some value. For example, a diagnosis of inflammatory bowel disease is greatly aided by a thorough microbiological assessment that is negative.[8]

Stool culture studies are important also to provide a guide for the use of empiric antibiotics. The American College of Gastroenterology has guidelines giving the indications for empiric antibiotic treatment in patients suffering from infectious diarrhoea, and these are supported by many current authorities in the field of emergency medicine and infectious diseases.[2 3 8] The evidence to support the increasing use of quinolones in this respect is substantial. There are at least three randomised controlled trials that show that empiric ciprofloxacin is more effective than placebo and is associated with significantly faster improvement of symptoms.[10–12] Interestingly, one of these studies even showed that a significant reduction in the duration

of diarrhoea and other symptoms was observed regardless of whether a pathogen was detected (p=0.0001).[10] A study of stool cultures in an ED setting in Israel also found that ciprofloxacin is associated with the least antimicrobial resistance, among other antibiotics (for example, ampicillin and trimethoprim-sulfamethoxazole) used for empiric treatment of gastroenteritis.[13] However other studies have shown reported increases in quinolone resistant campylobacter infections, which were associated with symptomatic relapse during treatment.[14–16] In our study, even though 92.3% of pathogens identified were sensitive to ciprofloxacin, seven of nine campylobacter positive samples were resistant to ciprofloxacin; and these findings have important implications on the choice of empiric antimicrobial agent for gastroenteritis in our locality.

A high incidence of *V parahaemolyticus* (42.3%) among positive stool cultures is observed in the studied population. This is by far the commonest cause of bacterial enteritis in Japan as well,[2] and the organism is present in coastal seawater. Raw fish, raw oysters, and inadequately cooked seafood are the most common sources. This prevalence may in part be related to the dietary habits of the people in Hong Kong, including that of ingestion of raw fish, and inadequately cooked seafood. Here then is an important implication for improving public health measures, and attention should be focused on legislating stricter regulations in the storage and preparation of raw fish, raw oysters, as well as public education that seafood should be adequately cooked. One large outbreak of *V parahaemolyticus* gastroenteritis, associated with ingestion of raw oysters, occurred in May and June of 1998 in Texas, and reportedly involved 416 patients.[17] The latest IDSA guidelines recommend that seafood or seacoast exposure should prompt culture for *Vibrio sp*.[8] Many cases of vibrio associated gastroenteritis are under-recognised because most clinical laboratories do not routinely use the selective medium, thiosulfate-citrate-bile salts-sucrose (TCBS) agar, for processing of stool specimen, unless specifically requested to do so.[17–19]

This study may be influenced by seasonal and epidemiological variations. Seasonal variations have been minimised by analysing results over a 12 month period. Of note, some important pathogens capable of causing invasive bacterial enteritis, such as *Yersinia* and *E Coli* 0157:H7, were not isolated. The geographical variation of the range of bacterial pathogens isolated should be noted. The range is also influenced by the age of the patient, this study looking only at adult patients as compared with the paediatric population. Furthermore, this is a study only of patients treated as outpatients. The clinical features of patients who require hospitalisation will no doubt be different, and the range of pathogens may not be the same. By contrast, in a study of the aetiology of acute diarrhoea in hospitalised children, conducted in the same institution, *Salmonella sp* was by far the commonest bacterial pathogen (76.7%) isolated.[20]

Correlating the presenting symptoms with the organism identified has led to several interesting observations. Salmonella positive patients presented with higher body temperatures compared with others. Shigella positive patients were more likely than others to present with bloody diarrhoea. Campylobacter positive patients at presentation had a significantly longer duration of abdominal pain at presentation, and were less likely to be dehydrated or required intravenous fluid therapy. These findings, however, must be viewed with caution, with consideration that they are derived from a very selected population. Further studies to identify the distinguishing clinical features of campylobacter infection may be practically relevant, especially when considering empiric antibiotics treatment for a patient, in view of the high level of ciprofloxacin resistance to *Campylobacter spp* found in this study population.

Finally our study is limited by being retrospective in nature. The extent to which information is deficient from each category of data has been taken into account, and shown in tables 1 and 2. Some information, such as the duration of symptoms before presentation, could not be more precisely obtained, and hence it was recorded in number of days instead of hours. We collected data of the clinical features as patients presented to the ED, which did not cover the progress of the symptoms after discharge from ED.

In conclusion, our study has revealed the characteristic presenting clinical features of adult patients with positive stool cultures, treated for acute gastroenteritis in an ED setting in Hong Kong. The role of stool cultures in the management of individual patients may be debatable, yet studies of stool cultures have definite public health benefits, and are important to provide a rational basis for empiric antibiotic treatment. Future research might focus on deriving a prediction rule for positive stool culture, and to analyse the sensitivity, specificity, and predictive values of such a rule. Several interesting clinical observations, relating to the pathogens identified, have been reported, and their implications discussed.

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