

## ***Vibrio parahaemolyticus*: a leading cause of infectious diarrhoea in Hong Kong**

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*Vibrio parahaemolyticus* is one of the commonest pathogens responsible for infectious diarrhoea in Asia. This article highlights recent findings from a retrospective study in an A&E Department in Hong Kong, and reviews current literature in regard to the epidemiological features and laboratory investigations. Prevention, prompt diagnosis and treatment are discussed. *Vibrio parahaemolyticus* gastroenteritis causes significant morbidity, and is much more prevalent in the summer season. Compared to other bacterial gastroenteritis, patients with this condition may present relatively sooner after the onset of diarrhoea. To ensure prompt detection of outbreaks, an appropriate stool culture medium specific for *Vibrio spp.* should be used. (*Hong Kong j.emerg.med.* 2002;9:23-29)

**Keywords:** Gastroenteritis, infectious diarrhoea, *Vibrio parahaemolyticus*

### **Background**

*Vibrio parahaemolyticus* is one of the commonest pathogens responsible for infectious diarrhoea in Asia,<sup>1</sup> and reportedly the commonest cause in Japan<sup>2,3</sup> and Taiwan.<sup>3,4</sup> It is the commonest source of food-poisoning in Hong Kong.<sup>5</sup> This article reports on findings from a recent research project on acute bacterial gastroenteritis in Hong Kong,<sup>6</sup> and is focused on *V. parahaemolyticus*. Clinical, laboratory and epidemiological features of patients presenting

to the emergency department suffering from *V. parahaemolyticus* gastroenteritis were studied in detail, and relevant literature reviewed. Important aspects relating to the measures of prevention, control and treatment of this commonly encountered infection are discussed.

### **Methods**

Review of a database was performed in the setting of the Accident & Emergency (A&E) department of an university-affiliated urban hospital in Hong Kong, with an annual attendance of 190,000. This database was part of an ongoing research project on acute bacterial gastroenteritis, and contained details of the demographic, clinical and laboratory details of all adult patients (age  $\geq 16$ ) who presented to the A&E department between 1 January 1999 and 31 December 1999 with acute gastroenteritis, who were treated as outpatients with or without a period of observation, and who also had positive stool cultures. Information from this database had been collected through retrospective review of the relevant clinical records. Patients with stool positive for *V. parahaemolyticus* were identified, and presenting clinical features were studied and also analyzed in

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comparison to those of other cases of bacterial gastroenteritis. Statistical comparisons were performed with Statview (Abacus concepts) version 5.0 using Fisher's exact and Mann-Whitney U tests as appropriate.

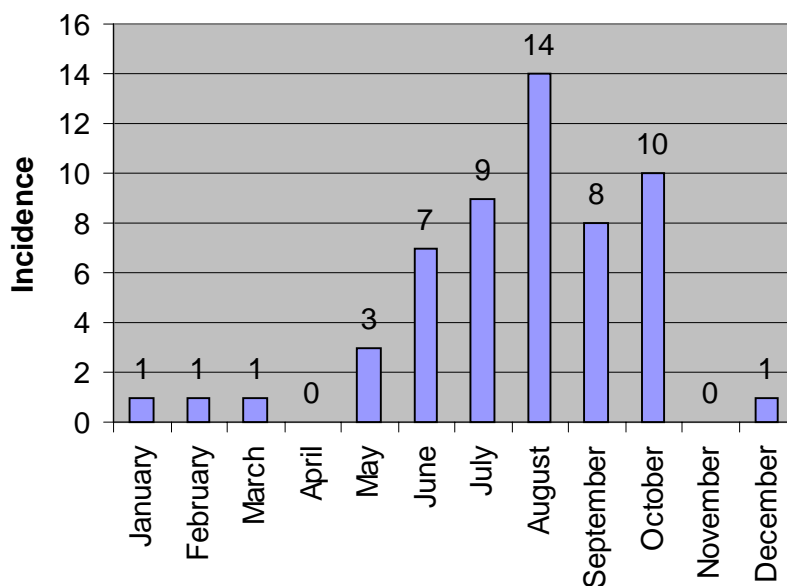
## Results

A total of 55 adult patients (26 females and 29 males) had *Vibrio parahaemolyticus* gastroenteritis during the 12-month study period. The median age in years was 38 (range 16-76). Mean (SD) highest body (oral) temperature recorded at presentation was 37.3 (0.8)°C, with a median of 37.2°C and range 36.0-39.0°C. There were 23 (41.8%) patients with fever of oral temperature  $\geq 37.6^\circ\text{C}$ . Bloody diarrhoea was present in 4 (7.3%) patients. Mean (SD) number of unformed stools per day at presentation was 10 (5.8). Mean (SD) duration of diarrhoea, from onset to completion of stay in A&E, was 1.4 (2) days. Fifty (91%) patients complained of abdominal pain, and the mean (SD) duration of abdominal pain from onset to completion of stay in A&E was 1.1 (1.1) days. Thirty (54.5%) patients had vomiting at presentation. Intravenous

fluid therapy was required in 21 (38.1%) patients. Observation unit admission was required in 24 (43.6%) patients. Recent travel to a rural region was reported by 7 patients (2 Thailand, and 5 Mainland China). All patients were treated successfully as outpatients, with satisfactory resolution of symptoms and no need for subsequent hospitalisation. Empiric antibiotic (ciprofloxacin) was given in 6 cases. Food-poisoning was suspected by history at presentation, and reported to the Department of Health, in 4 (7.3%) cases. The monthly distribution of cases is shown in Figure 1.

Antibiotic susceptibilities of the *V. parahaemolyticus* isolates to five antimicrobials, trimethoprim-sulfamethoxazole, chloramphenicol, ampicillin, ciprofloxacin and cefotaxime, were determined. All isolates were susceptible to trimethoprim-sulfamethoxazole, chloramphenicol and cefotaxime, but resistant to ampicillin. Fifty-three isolates were susceptible to ciprofloxacin while the remaining two were of intermediate susceptibility to ciprofloxacin.

Statistical comparisons were made between the clinical features at presentation of *V. parahaemolyticus* positive patients (n=55) and those of patients with stool culture



**Figure 1.** Incidence of *Vibrio parahaemolyticus* gastroenteritis against month of year in 1999.

positive for other bacterial pathogens during the same study period (n=75), including *Shigella*, *Salmonella*, and *Campylobacter*. *V. parahaemolyticus* patients, compared to non-*V. parahaemolyticus* patients, presented to A&E with a significantly shorter mean (SD) duration of diarrhoea [1.4 (1.9) days v. 2.6 (2.8) days, P=0.0062]. There was no significant difference (P ≥0.05) between the two groups in regard to the following parameters: i) mean highest body temperature at presentation; ii) incidence of bloody diarrhoea; iii) number of loose stools per day; and iv) mean duration of abdominal pain at presentation.

## Discussion

*Vibrio parahaemolyticus* is a halophilic gram-negative bacillus that freely inhabits the ocean, mainly coastal waters worldwide.<sup>7,8</sup> Infections are usually sporadic, but foodborne major outbreaks of gastroenteritis have been reported in the United States, mainly involving coastal areas, during the warmer months, and associated with consumption of raw oysters.<sup>8-12</sup> These recent outbreaks had occurred in the Pacific U.S. northwest coast (the U.S. states of Washington, Oregon, California, and British Columbia in Canada)

in 1997; the Atlantic U.S. northeast coast (Connecticut, New Jersey and New York) in 1998; and the Gulf Coast (Texas) in 1998.

Apart from raw oysters, *V. parahaemolyticus* infections are also acquired by consumption of other raw or undercooked shellfish and seafood. The organism can be recovered from a high percentage of fresh and refrigerated seafood and even from frozen items, including crabs, shrimps and fish.<sup>4</sup> Crabs and shrimps have been reported to be the sources of outbreaks.<sup>13</sup> *V. parahaemolyticus* infections can also be acquired from skin wounds exposed to warm seawater, and may result in wound infection and even septicaemia.<sup>7</sup> A case of fulminating necrotizing fasciitis had been reported in Singapore.<sup>14</sup> It was also isolated in Danish coastal seawater, causing ear infections.<sup>15</sup> Reactive arthritis may be a complication of *V. parahaemolyticus* gastroenteritis.<sup>16</sup>

## Clinical and epidemiological features

Table 1 lists the clinical features of *V. parahaemolyticus* gastroenteritis from various U.S. databases, compared to findings in our present study. The clinical features

**Table 1.** Clinical features of *Vibrio parahaemolyticus* gastroenteritis, from various case series.

	Pacific Northwest 1997 (outbreak) <sup>9</sup>	Northeast Atlantic Coast 1998 (outbreak) <sup>10</sup>	Texas 1998 (outbreak) <sup>8</sup>	Gulf Coast States, USA (Florida, Alabama, Louisiana and Texas) 1988-97 (sporadic cases) <sup>12</sup>	Hong Kong 1999 (sporadic cases over a 12-month period, in one regional hospital)
Number of patients	196	17	296	202	55
Incubation period (hrs)	Mean:15 Range:4-96	Median:19 Range:12-52	*	*	*
Duration of illness (days)	3 (mean)	5 (median)	5 (median)	6 (median)	*
Diarrhoea (%)	99	100	100	98	100
Abdominal pain (%)	88	94	92	89	91
Vomiting (%)	39	82	42	55	54
Fever (%)	33	47	46	52	42
Bloody stools (%)	12	29	9	29	7
Hospitalization (n)	2	*	15	38	0+

\*data not available

+ patients immediately hospitalized were not included in the study

are essentially similar, except that bloody diarrhoea is not as frequently recorded in our case series.

A significant proportion of our patients required intravenous therapy (38.1%) and observation unit admission (43.6%), and this suggests that *V. parahaemolyticus* causes an illness that is not without significant morbidity. Its impact to the community is appreciable, since it is the commonest source of food-poisoning outbreaks in Hong Kong. Hong Kong Department of Health data shows that in 1999, there was a total of 90 confirmed outbreaks of *V. parahaemolyticus* food-poisoning, affecting 519 persons (personal communication). It was responsible for 36% of all outbreaks in 2000.<sup>5</sup>

Findings from our study suggest that *V. parahaemolyticus* gastroenteritis may be distinguishable clinically from other bacterial causes of gastroenteritis, by a presentation to A&E comparatively sooner after onset of severe diarrhoea. It is likely that the characteristic symptoms of this condition often raise patients' concern in such a way that medical attention is sought for at a relatively early stage. Further larger prospective studies are required to confirm this finding. The study population setting was urban Hong Kong, and it appears that most cases were not acquired from travel abroad. Only 7 patients (12.7%) reported history of recent travel to a rural area.

In our study, 92.7% (51/55) sporadic cases occurred between the months of May and October, inclusive, (Figure 1) and peaking in August. A similar trend is seen with the monthly incidence of reported *V. parahaemolyticus* food-poisoning outbreaks in Hong Kong in 1999. (Table 2) This marked increase in incidence in the summer months is consistent with other reports. All the U.S. outbreaks mentioned above have occurred in the summer months, in which the concentration of *V. parahaemolyticus* in seawater increases with increasing water temperature. Sporadic cases are also noted to be more common in the summer months.<sup>11,13</sup> Similarly, the incidence of outbreaks in Taiwan are also consistently higher between the summer months of May and September.<sup>3</sup> This seasonal trend suggests that seawater temperature may be an

important factor for *V. parahaemolyticus* infections. In the U.S. the number of reported outbreaks in the past several years has increased steadily, with a sharp rise after 1997. It is postulated that warmer sea temperatures (the El Nino effect) has resulted in the emergence of more virulent serotypes.<sup>13</sup> *V. parahaemolyticus* causing gastroenteritis is also prevalent in India, Indonesia, Thailand and New Zealand.<sup>17-20</sup>

## Laboratory investigations

The organism may be isolated from blood or stool specimens from infected patients. Many cases of gastroenteritis caused by *Vibrio spp.* are undetected by stool cultures because *Vibrios* are not easily identified on routine enteric media. Isolation of *Vibrios* from stool is greatly enhanced through the use of a selective medium, particularly thiosulfate-citrate-bile salts-sucrose agar (TCBS).<sup>8,21</sup> Using other enteric agars together with commercial biochemical identification systems to identify *Vibrio spp.* yielded accurate results only 50% of the time.<sup>8</sup> TCBS agar should be used for primary laboratory isolation of *Vibrio* species.

**Table 2.** Monthly incidence of *V. parahaemolyticus* food-poisoning outbreaks notified to the Department of Health, Hong Kong, in 1999.

	No. of confirmed outbreaks	No. of patients affected
January	0	0
February	2	17
March	2	9
April	2	7
May	7	22
June	23	118
July	11	124
August	23	78
September	13	126
October	6	16
November	1	2
December	0	0
Total	90	519

Reports indicate that TCBS agar is underused in the U.S. Gulf Coast states.<sup>8</sup> In our institution, TCBS agar for identification of *V. parahaemolyticus* is routinely used in all stool cultures requested. Many authorities recommend that even in other countries where *V. parahaemolyticus* gastroenteritis is not as prevalent, TCBS agar should at least be used selectively, such as whenever there is a history of recent seafood exposure, and screening all stool cultures requested in the warmer months.<sup>8,22</sup>

Serologic tests can be performed for identification and serotyping isolates.<sup>3,4,13,17,19</sup> Molecular subtyping can also be performed by pulsed-field gel electrophoresis (PFGE), which may be useful in linking common source outbreaks.<sup>4,13</sup> Isolates can also be tested for virulence markers (thermostable direct haemolysin and thermostable direct-related haemolysin genes) using polymerase chain reaction.<sup>4,13,21</sup> The serovar O3:K6 was most frequently detected in Taiwan, and is thought to be the cause of unusually high incidence of food-borne disease outbreaks in Taiwan during 1996 to 1999.<sup>3</sup> This serovar first emerged in 1996 in Calcutta, India, and has since also appeared on the North American continent.<sup>10,11</sup>

## Treatment

Early administration of antibiotics has been suggested to improve survival for severe cases of *V. parahaemolyticus* infections,<sup>7,12,14</sup> hence the need for emergency physicians to consider the diagnosis and obtain careful histories in suspected cases. As for uncomplicated gastroenteritis caused by *V. parahaemolyticus*, antimicrobial treatment has not been shown to shorten the course of illness, and these cases require mainly supportive treatment to maintain hydration. Most series report a duration of illness of 5-6 days. (Table 1) By the time stool culture results are available in 3-5 days, patients would have almost fully recovered. Empiric antibiotic therapy with fluoroquinolones has been shown to be effective against moderate to severe infectious diarrhoea in adult patients, in general, in shortening the duration of symptoms,<sup>23-26</sup> and has been

advocated by many authorities.<sup>2,22,27-30</sup> However, further studies are needed to investigate whether the same benefits are seen specifically in *V. parahaemolyticus* infections.

We report that the pathological strains in our series are sensitive to ciprofloxacin (fluoroquinolone), cefotaxime (third generation cephalosporin), trimethoprim-sulfamethoxazole, and chloramphenicol. The organism is also known to be sensitive to doxycycline.<sup>6,12,14</sup> Hence, one of the above antimicrobial agents should be included in the empiric treatment of severe sepsis, gastroenteritis, or wound infections in patients with history of seafood or marine exposure, especially those with hepatic cirrhosis or immunosuppression such as adrenal insufficiency.<sup>7,12,14</sup>

## Prevention and control

Public education of proper food handling, preparation and storage, and avoidance of raw or undercooked seafood consumption is important. Patients with chronic liver disease and immunosuppression are at higher risks and should especially be counselled to avoid ingestion of live and raw seafood, and avoid swimming in warm marine waters. More effective guidelines should be developed for regulating the harvesting of oysters and clams,<sup>9,11,13,31</sup> including banning harvesting of oysters during warmer months (when seawater temperatures and *Vibrio* counts are usually elevated), or diverting oysters harvested during the warmer months for cooking or pasteurization. Prompt recognition of outbreaks by clinicians, clinical laboratories, and public health authorities is essential. Stool should be sent for culture in suspected cases. Clinical laboratories in coastal areas or *V. parahaemolyticus* prevalent areas should be encouraged to use TCBS agar when culturing stool specimens, particular during the summer months. Public health authorities should consider making infections with *V. parahaemolyticus* a reportable condition. Currently it is not a notifiable condition in most U.S. states, except the Gulf Coast states.<sup>8-11,13</sup> In Hong Kong, the isolation of *V. parahaemolyticus* from stool specimen is not by

itself a notifiable condition, unless an outbreak of food-poisoning is suggested by history.

## Conclusion

*V. parahaemolyticus* is increasingly recognised as an important cause of infectious diarrhoea. It causes significant morbidity in patients affected in Hong Kong, many of whom require intravenous fluid replacement and observation unit utilisation, and it is much more prevalent in the summer season. Emergency physicians should be aware of the possibility of *V. parahaemolyticus* infection in patients presenting with diarrhoea, with a history of consumption of raw oysters or other seafood within the preceding 4 days (mean incubation period, 15 hours, range 4-96 hours).<sup>10</sup> Our findings also indicate that patients usually present relatively soon after the onset of diarrhoea. To ensure prompt detection of outbreaks, appropriate stool cultures specific for *Vibrio spp.* should be requested.<sup>22</sup> The emergence of this infectious disease should be carefully monitored internationally.

## Acknowledgement

The authors would like to thank the Department of Health, Hong Kong, for supplying valuable data, and for the permission to include it in this paper.

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