CLINICAL FEATURES OF GASTROINTESTINAL SALMONELLOSIS IN CHILDREN IN BANGKOK, THAILAND

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Abstract. This retrospective descriptive study was conducted at Queen Sirikit National Institute of Child Health (QSNICH), Bangkok, Thailand to describe the clinical features of gastrointestinal salmonellosis in children. The medical records of 134 patients admitted to QSNICH in 2009 who had a positive stool culture for *Salmonella* spp were reviewed. Demographic, clinical, laboratory, treatment, culture and antimicrobial sensitivity data were collected and analyzed. The mean age of the patients was 22.9 months (range 0.5 to 158 months); 76.9% were < 2 years old. The male to female ratio was 1.5:1. *Salmonella* B was most commonly found serogroup (47%). The common clinical manifestations included diarrhea (99.3%), fever (93.3%), dehydration (64.9%) and nausea/vomiting (48.5%). Most of the *Salmonella* isolates were sensitive to a fluoroquinolone and many were sensitive to Cotrimoxazole, but few were sensitive to ampicillin. There were no significant differences in the clinical manifestations and drug sensitivities of the different *Salmonella* serogroups, except convulsions were more common in *Salmonella* E infected patients ($p = 0.04$) and more *Salmonella* C isolates were sensitive to ampicillin ($p = 0.04$). There was no significant correlation between clinical course and antimicrobial treatment, except the duration of diarrhea was significantly longer in patients who received antimicrobial treatment (mean 6.1, SD 4.7 days *vs* mean 4.2, SD 2.1 days) ($p = 0.03$). Three patients had *Salmonella* bacteremia. Three patients died but not directly due to *Salmonella* infection.

Keywords: *Salmonella*, gastrointestinal infection, antimicrobial sensitivity, children, Thailand

INTRODUCTION

Salmonella infections occur worldwide. The prevalence of *Salmonella* infection varies depending on the water supply, waste disposal, food preparation practices, and climate. In children the most common illness caused by *Salmonella* is gastroenteritis (Cleary, 2004). Even in developed countries, *Salmonella* infection is still an important health problem. In the United States, *Salmonella* is the most commonly isolated pathogen causing food-borne illness. In Australia, it is the

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second most commonly isolated food pathogen after *Campylobacter pylori*. This may be due to production of processed food (Darby and Sheorey, 2008). There is little information on the epidemiology and burden of *Salmonella* gastroenteritis in developing countries, but *Salmonella* infections are a major cause of childhood diarrheal illness (Bhutta, 2007). Studies from developed and developing countries show *Salmonella* multidrug resistance is increasing (CellaiRustici *et al*, 2006; Chiu *et al*, 2006; Huang *et al*, 2007; Kariuki *et al*, 2006b).

Gastrointestinal salmonellosis may be complicated by invasive infection (Yang *et al*, 2002; Trevejo *et al*, 2003; Kariuki *et al*, 2006a). It is important to have a good knowledge of the clinical features, causative serotypes and responses to antimicrobial therapy of gastrointestinal salmonellosis to provide appropriate patient management and prevent complications. We report the clinical features of gastrointestinal salmonellosis in pediatric patients admitted to Queen Sirikit National Institute of Child Health (QSNICH), Bangkok, Thailand.

MATERIALS AND METHODS

This study was a retrospective descriptive study conducted at QSNICH, a tertiary-care pediatric hospital in Bangkok, Thailand. The hospital laboratory database was searched and the charts of patients who had a stool culture positive for *Salmonella* spp were obtained. Because completeness of data is essential in a retrospective study, only in-patients were included in the study. The medical records of these patients were reviewed. The demographic data, laboratory results, antimicrobial treatment, culture and antimicrobial sensitivity data were obtained.

Table 1
Demographic characteristics of the patients with gastrointestinal salmonellosis.

Characteristics	Number (%)
Sex	
Male	81 (60.4)
Female	53 (39.6)
Age (months)	
0-6	22 (16.4)
7-12	58 (43.3)
13-24	23 (17.2)
25-60	17 (12.7)
61-120	9 (6.7)
>120	5 (3.7)
Range	0.5 - 158
Mean (SD)	22.9 (31.1)
Nutritional status	
By weight (n = 133)	
Normal	111 (83.4)
Malnourished	17 (12.8)
Over-nourished	5 (3.8)
By height (n = 100)	
Normal	81 (81.0)
Stunted	12 (12.0)
Tall	7 (7.0)

Kazemi *et al* (1974) found 77 of 117 patients (65.8%) with *Salmonella* gastroenteritis had fever; and the worst acceptable proportion of fever is 15% different from this datum, then the estimated sample size was 88. However, to obtain the data regarding seasonal variation of *Salmonella* infection, we collected data from all patients who were admitted to QSNICH during 2009.

Data were analyzed using the Statistical Package Software version 11.5 (SPSS 11.5). Descriptive statistics were applied for demographic data. The chi-square test or Fischer-exact test were used for comparing categorical variables and the Student's *t*-test or Wilcoxon ranked-sum test or one way ANOVA test were used for comparing continuous variables where appropriate.

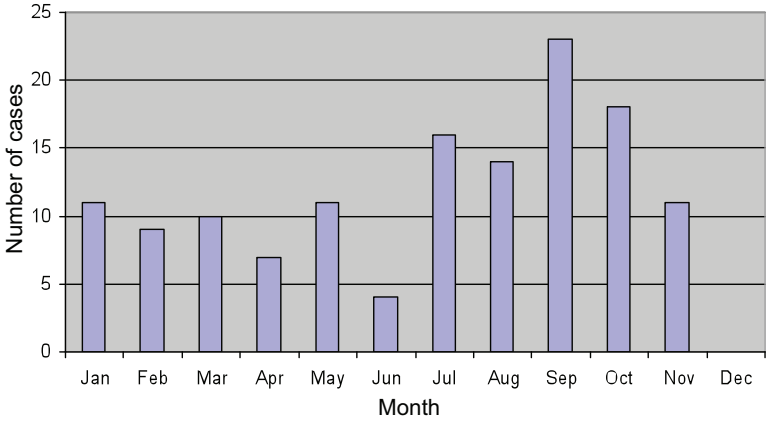

Fig 1–Monthly incidence of *Salmonella* infection.

This study was approved by the Ethics Committee of the Faculty of Tropical Medicine, Mahidol University, and the Queen Sirikit National Institute of Child Health.

RESULTS

During 2009, 135 in-patients had stool cultures positive for *Salmonella* spp. The medical data from 1 patient was absent. Therefore only 134 patients were included in this study.

The demographic characteristics of the patients are described in Table 1. Most subjects [103 (76.9%)] were < 2 years old. The cases presented all year-round except during December when there were no cases. The incidence was highest during July to October (Fig 1). Only non-typhoidal salmonellas (NTS) were found in this study. *Salmonella* B was found in 63 cases (47.0%), *Salmonella* C in 36 cases (26.9%), *Salmonella* D in 20 cases (14.9%), *Salmonella* E in 13 cases (9.7%) and *Salmonella* G in 2 cases (1.5%).

The admission diagnoses included acute gastroenteritis in 109 cases (81.3%), infective diarrhea in 13 cases (9.7%), pneumonia in 4 cases (3.0%), acute lymphoblastic leukemia (ALL) in 2 cases (1.5%), persistent diarrhea in 2 cases (1.5%) and one case each for malabsorption, chronic diarrhea, intestinal neuronal dysplasia and septic shock. Some patients had co-morbid conditions (Table 2). Other enteropathogens were also found in the stool of 30 patients (22.4%) (Table 2).

The clinical manifestations of the patients are presented in Tables 3, 4 and 5. The mean (SD) peak temperature was 38.6 (1.1) degrees Celsius. There was no significant difference in the clinical manifestations among the different *Salmonella* serogroups, except convulsions were more common in *Salmonella* E [4/13 patients (30.8%)] ($p = 0.04$). For each clinical symptom the duration was calculated for only the patients who had that symptom. There was no significant difference in the duration of clinical manifestations among the different *Salmonella* serogroups. A complete blood count revealed a wide range in total leukocyte counts, from leukopenia to leukocytosis. Serum electrolytes were measured in 121 children. Fifty cases (41.3%) had hyponatremia (sodium < 135 mEq/l) and 10 (8.3%) had hypokalemia (potassium < 3.5 mEq/l). Severe hyponatremia (sodium < 130 mEq/l) was found in 4 cases (3.3%) and severe hypokalemia (potassium < 3 mEq/l) was found in 3 cases (2.5%). Significant acidosis (bicarbonate < 15 mEq/l) was found in 20 cases (16.5%).

Regarding stool examinations, 76 (57.6%), 35 (26.5), and 21 (15.9%) had soft, loose and watery stools, respectively. Microscopic examination was done in

Table 2
Co-morbid conditions in patients with gastrointestinal salmonellosis.

Characteristics	Number (%)
Other enteropathogen coinfections	30 (22.4)
Aeromonas spp	8
Aeromonas caviae	8
Aeromonas hydrophila	8
Aeromonas sobria	7
Plesiomonas shigelloides	5
Rota virus	3
Vibrio spp	2
Respiratory disease	24 (17.9)
Pneumonia	14
Bronchitis	8
Upper respiratory tract infection	1
Pulmonary tuberculosis	1
Other gastrointestinal abnormalities	11 (8.2)
Hirschsprung disease	3
Cow's milk protein allergy	3
Congenital CMV or HSV infection with malabsorption	1
Crohn's disease	1
Intestinal neuronal dysplasia	1
Colitis	1
Bile acid diarrhea	1
Other systemic infections	10 (7.5)
Septic shock	3
Sepsis	2
Roseolar infantum	2
Upper urinary tract infection	1
Dengue fever	1
Dengue hemorrhagic fever (grade 1)	1
Malignancy	5 (3.7)
Acute lymphoblastic leukemia	3
Hepatoblastoma	1
Neuroblastoma	1
HIV infection	2 (1.5)

CMV, cytomegalovirus; HSV, herpes simplex virus; HIV, human immunodeficiency virus.

120 patients. Thirty-two patients (26.7%) had no white blood cell (WBC) in stools and 24 patients (20%) had >10 WBC/hpf. Sixty-two patients (51.7%) had no red blood cells (RBC) in their stool and 13 patients (10.8%) had >10 RBC/hpf. Stool for occult blood was tested in 47 patients and was positive in 38 patients (80.9%).

Blood cultures were taken in 84 patients (62.7%) and positive results occurred in 11 patients (13.1%): 3 were coagulase negative *Staphylococcus*, 2 were *Klebsiella pneumoniae*, and 1 each were *Pseudomonas* spp, *P. aeruginosa*, and co-infection with *P. aeruginosa* and *Enterobacter* spp. *Salmonella* spp were found in 3 patients:

Table 3
Clinical manifestations of different *Salmonella* serogroups (number/total (%)).

Clinical manifestations	*Sal.* B	*Sal.* C	*Sal.* D	*Sal.* E	*Sal.* G	Total	*p*-value
Diarrhea	63/63 (100)	36/36 (100)	19/20 (95)	13/13 (100)	2/2 (100)	133/134 (99.3)	0.22
Fever	59/63 (93.7)	32/36 (88.9)	19/20 (95.0)	13/13 (100)	2/2 (100)	125/134 (93.3)	0.68
Nausea/vomiting	32/61 (52.5)	13/33 (39.4)	13/17 (76.5)	6/13 (46.2)	1/2 (50.0)	65/126 (51.6)	0.17
Anorexia	15/60 (25.0)	8/34 (23.5)	10/18 (55.6)	5/13 (38.5)	1/2 (50.0)	39/127 (30.7)	0.10
Convulsions	3/63 (4.8)	2/35 (5.7)	2/20 (10.0)	4/13 (30.8)	0/2 (0)	11/133 (8.3)	0.04
Abdominal pain	2/59 (3.4)	3/34 (8.8)	1/19 (5.3)	1/12 (8.3)	0/2 (0)	7/126 (5.6)	0.82
Headache	0/62 (0)	2/33 (6.1)	1/17 (5.9)	1/12 (8.3)	0/2 (0)	4/126 (3.2)	0.35
Hepatomegaly	5/63 (7.9)	2/35 (5.7)	1/20 (5.0)	4/13 (30.8)	0/2 (0)	12/133 (9.0)	0.07
Splenomegaly	4/63 (6.3)	2/35 (5.7)	1/20 (5.0)	2/13 (15.4)	0/2 (0)	9/133 (6.8)	0.76
Rash	4/63 (6.3)	1/35 (2.9)	0/20 (0)	0/13 (0)	0/2 (0)	5/133 (3.8)	0.62
Dehydration							0.11
No	21/63 (33.3)	14/36 (38.9)	5/20 (25.0)	7/13 (53.8)	0/2 (0)	47/134 (35.1)	
Mild	17/63 (27.0)	9/36 (25.0)	5/20 (25.0)	3/13 (23.1)	1/2 (50.0)	35/134 (26.1)	
Moderate	24/63 (38.1)	10/36 (27.8)	9/20 (45.0)	3/13 (23.1)	0/2 (0)	46/134 (34.3)	
Severe	1/63 (1.6)	3/36 (8.3)	1/20 (5.0)	0/13 (0)	1/2 (50.0)	6/134 (4.5)	

Sal, Salmonella

one each for *Salmonella* Choleraesuis, *Salmonella* B and *Salmonella* D. The organisms in stool and blood were the same for *Salmonella* B and D but the patient who had *Salmonella* Choleraesuis in the blood had *Salmonella* B in the stool. This patient also had HIV infection.

Of the patients who had no co-morbidity, the important clinical and laboratory findings are summarized in Table 6. There were no differences in these manifestations between patients who had only *Salmonella* infection and those who were co-infected with other enteropathogens, except patients co-infected with other enteropathogens more commonly had soft stool and less commonly had watery or loose stool. The duration of fever in the patients who had no co-morbid infections were shorter than the overall patients.

The drug sensitivity patterns of *Salmonella* isolates are shown in Table 7. The drug sensitivities for one *Salmonella* B isolate were absent. There were no significant differences in the drug sensitivity patterns among the different *Salmonella* serogroups, except for *Salmonella* C which was more sensitive to ampicillin than the other serotypes. Nearly all the *Salmonella* isolates were sensitive to fluoroquinolone and a high percentage were sensitive to Cotrimoxazole, but few were sensitive to ampicillin.

Table 4
Duration of clinical symptoms in gastrointestinal salmonellosis.

Clinical symptoms	Duration (days)	
	Mean (SD)	Range
Duration of fever; *n* = 125	5.4 (5.0)	1-35
Duration of diarrhea; *n* = 133	5.7 (4.4)	1-30
Duration of nausea/vomiting; *n* = 65	2.4 (1.8)	1-8
Duration of anorexia; *n* = 39	1.9 (1.5)	1-7
Duration of abdominal pain; *n* = 7	2.3 (1.6)	1-5
Duration of headache; *n* = 4	4.3 (2.2)	2-7

Table 5
Hematologic and biochemistry findings in gastrointestinal salmonellosis.

Laboratory	Range	Mean (SD)
Total leukocytes (/µl)	100-30,790	12,541.0 (5,570.9)
Neutrophils (%)	0-94	53.8 (21.8)
Lymphocytes (%)	0-88	37.9 (19.6)
Monocytes (%)	0-18	5.6 (3.7)
Eosinophils (%)	0-10	0.4 (1.3)
Basophils (%)	0-2	0.1 (0.4)
Hemoglobin (g/dl)	4.6-14.8	11.2 (1.6)
Hematocrit (%)	14.6-43.1	34.3 (4.5)
Platelets (/µl)	11,000-810,000	362,492.5 (150,411.9)
ESR (mm/hour); *n* = 4	14-81	39.8 (29.7)
Na^+ (mEq/l); *n* =121	125-142	135.1 (2.9)
K (mEq/l); *n* = 121	2.2-5.6	4.4 (0.6)
HCO_{3^-} (mEq/l); *n* = 121	7.8-28.8	18.9 (3.9)
Cl^- (mEq/l); *n* = 121	93-126	104.9 (4.3)
BUN (mg/dl); *n* = 29	1.4-40.4	10.1 (8.5)
Creatinine (mg/dl); *n* = 29	0.1-2.4	0.4 (0.4)
Total leukocyte (/µl)[a]	2,440-30,790	12,723 (5,408)
Neutrophils (%)[a]	3-94	54.6 (21.0)
Hemoglobin (g/dl)[a]	6.4-14.8	11.4 (1.5)

[a]Two patients who had malignancy and leukocytes < 1,000/µl excluded

Antimicrobials were prescribed in 107 patients (79.9%). The most commonly prescribed antimicrobials were ceftriaxone/cefotaxime or fluoroquinolone alone or in combination (Table 8). The day of illness when the antimicrobials were started ranged from day 1 to day 9 [mean (SD) 1.5 (1.3)].

Antimicrobial treatment did not influence the duration of clinical symptoms, except the duration of diarrhea was significantly longer in patients who received antimicrobial treatment (Table 9). There were no significant differences in duration of diarrhea among patients treated with different antimicrobial regimens.

Table 6
Clinical and laboratory manifestations in patients with gastrointestinal salmonellosis who had no other co-morbidities [number/total (%)].

Clinical manifestation	*Salmonella* only	*Salmonella* co-infected with other enteropathogen	*p*-value
Diarrhea	41/41 (100)	16/17 (94.1)	0.29
Fever	37/41 (90.2)	15/17 (88.2)	1.00
Nausea/vomiting	19/40 (47.5)	10/15 (66.7)	0.33
Anorexia	12/40 (30.0)	3/15 (20.0)	0.52
Convulsions	3/41 (7.3)	2/16 (12.5)	0.61
Abdominal pain	3/40 (7.5)	1/16 (6.3)	1.00
Hepatomegaly	2/41 (4.9)	0/16	1.00
Splenomegaly	1/41 (2.4)	0/16	1.00
Rash	1/41 (2.4)	0/16	1.00
Dehydration			0.79
No	10/41 (24.4)	6/17 (35.3)	
Mild	14/41 (34.1)	5/17 (29.4)	
Moderate	16/41 (39.0)	6/17 (35.3)	
Severe	1/41 (2.4)	0/17	
Stool examination			
Consistency			0.05
Soft	20/41 (48.8)	14/17 (82.4)	
Watery	8/41 (19.5)	2/17 (11.8)	
Loose	13/41 (31.7)	1/17 (5.9)	
Mucous/bloody	7/41 (17.1)	4/17 (23.5)	0.71
Positive for occult blood	15/18 (36.6)	4/6 (66.7)	0.57
Complete blood count [mean(SD)]			
Total leukocyte (/μl)	11,936.8 (3,965.9)	11,648.8 (5,397.4)	0.82
Neutrophils (%)	52.7 (21.1)	49.7 (20.5)	0.62
Lymphocytes (%)	41.0 (19.9)	43.5 (18.9)	0.66
Duration of symptoms (day)[mean(SD)]			
Fever	3.4 (1.8)	4.1 (2.5)	0.24
Diarrhea	4.4 (3.1)	4.9 (2.8)	0.58
Nausea/vomiting	1.8 (1.4)	2.1 (1.1)	0.54
Anorexia	1.8 (1.6)	1.7 (1.2)	0.08
Abdominal pain	2.3 (2.3)	4.0	0.60

There were 3 cases of *Salmonella* bacteremia in this study. The first case was a 30 month-old boy with AIDS. He had severe wasting, severe pneumonia, chronic otitis media and a perianal abscess. He had loose stool and a stool study showed 2-3 WBC/hpf. His stool culture was positive for *Salmonella* B but the blood culture was positive for *Salmonella* Choleraesuis. He recovered after treatment with ceftriaxone followed by norfloxacin. The second case was a previously healthy 11-month-old male infant. His admission diagnosis was acute gastroenteritis. He passed bloody mucousy stools and both blood and stool cultures were positive for *Salmonella* B. His

Table 7
Drug sensitivity of different *Salmonella* serogroups [number sensitive/total (%)].

	Sal B (*n*=62)	*Sal* C (*n*=36)	*Sal* D (*n*=20)	*Sal* E (*n*=13)	*Sal* G (*n*=2)	*p*-value
Ampicillin	13 (21.0)	23 (63.9)	9 (45.0)	5 (38.5)	0	0.001
Fluoroquinolone	61 (98.4)	36 (100)	20 (100)	13 (100)	2 (100)	0.89
Cotrimoxazole	52 (83.9)	30 (83.3)	14 (70.0)	9 (69.2)	2 (100)	0.47
Ceftriaxone	ND	ND	2 (100)	ND	ND	NA
Macrolide	1/1 (100)	ND	ND	ND	ND	NA

(ND, not done)

Table 8
Antimicrobial treatment in patients with *Salmonella* infection (*n*=107).

Treatment	Number of cases (%)
Fluoroquinolone	15 (14.0)
Ceftriaxone/cefotaxime	35 (32.7)
Ceftriaxone/cefotaxime followed by fluoroquinolone	35 (32.7)
Ceftriaxone/cefotaxime followed by cefdinir	9 (8.4)
Meropenem	2 (1.9)
Azithromycin	1 (0.9)
Cotrimoxazole	1 (0.9)
Multiple antimicrobials	9 (8.4)

Table 9
Correlation between duration (days) of clinical symptoms and antimicrobial treatment in patients with gastrointestinal salmonellosis.

Clinical symptom	Antimicrobial treatment [*n*; mean (SD)]		*p*-value
	Yes	No	
Duration of fever; *n* = 125	102; 5.4 (4.5)	23; 5.4 (6.9)	0.96
Duration of anorexia; *n* = 39	31; 1.8 (1.6)	8; 1.9 (1.1)	0.95
Duration of nausea/vomiting; *n* = 65	50; 2.5 (1.9)	15; 1.8 (1.0)	0.16
Duration of diarrhea; *n* = 133	106; 6.1 (4.7)	27; 4.2 (2.1)	0.002

stool culture was also positive for *Aeromonas sobria*. He recovered after being treated with ceftriaxone. The third case was a previously healthy 1-year-old female infant. She was admitted with the diagnosis of acute gastroenteritis and bronchitis. She passed loose stool containing occult blood but there were no RBC or WBC on stool microscopy. Both blood and stool cultures were positive for *Salmonella* D. She

recovered after treatment with ceftriaxone followed by norfloxacin. Three cases died: 2 had acute lymphoblastic leukemia, one had *Salmonella* C and the other had *Salmonella* E in the stool. Both cases died due to complications from sepsis. A hemoculture revealed *Pseudomonas aeruginosa* in one case and was negative in the other case. The third case was a 3-year-old boy who had pulmonic valve stenosis. He was admitted with septic shock, pneumonia and chronic hepatitis. His stool culture was positive for *Salmonella* B but his hemoculture was negative. He died from respiratory and renal failure and coagulopathy.

DISCUSSION

This study presents the clinical manifestations of gastrointestinal salmonellosis in children. The term "gastrointestinal salmonellosis" was used instead of "*Salmonella* gastroenteritis" because some patients had asymptomatic *Salmonella* infection, but the diarrhea and other clinical manifestations may be due to co-morbid conditions or other enteropathogens. This study was carried out among patients admitted to a tertiary-care hospital in Bangkok, Thailand. The clinical presentations and co-morbid conditions may be more severe than those of other patients.

The age distribution of patients in this study was similar to a study by Yang *et al* (2002) who reported 82.4% of patients were younger than 2 years old, and similar to another study by Kazemi *et al* (1974) who found 33% of patients were less than 1 year of age. In our study, the cases occurred year-round but the incidence was highest in the rainy season (July to October). Our study results are similar to studies from other tropical areas as seen in studies by Brent *et al* (2006) and Kariuki *et al* (2006a) who found the peak non-typhoidal salmonella bacteremia cases occurred during the rainy season. This is different from studies in non-tropical areas, as seen in studies by Kazemi *et al* (1974) and Olsen *et al* (2001) who found the majority of cases occurred during summer months.

The most common *Salmonella* serogroup found in this study was B followed by C and D. These findings are similar to a study by Lan *et al* (2009) in Taiwan who found *Salmonella* serogroup B was the most common (48.5%) and in studies by Kazemi *et al* (1974), Chiu *et al* (1999), Olsen *et al* (2001), Yang *et al* (2002), CellaiRustici *et al* (2006), Kariuki *et al* (2006a), Huang *et al* (2007), who found *Salmonella* Typhimurium (serogroup B) was the most common organism.

The common clinical manifestations of gastrointestinal salmonellosis in this study were diarrhea, fever, anorexia, nausea/vomiting and dehydration. Headache was rarely found in this study. This may be because most of the patients in this study were too young to describe their symptoms. Electrolyte imbalance and metabolic acidosis are not uncommon in these patients. There were no differences in the clinical manifestations of the different *Salmonella* serogroups. The finding that convulsion were more common in *Salmonella* E infected patients may be due to the small number of patients infected with this serogroup. The findings in this study are similar to previous studies (Kazemi *et al*, 1974; Delarocque-Astagneau *et al*, 2000; Brent *et al*, 2006; Galanakis *et al*, 2007; Lan *et al*, 2009). The clinical manifestations are similar to other gastroenteritis cases. Many of the patients in this study had co-morbid conditions that could modify their clinical presentation, but this did not appear to be the case in this study (Table 6).

One clue in the clinical diagnosis of

salmonellosis is the presence of fever. However, other causes of invasive diarrhea must be excluded, especially shigellosis, a common pathogen in developing countries.

In addition to stool culture, stool examination may be helpful for the early diagnosis of gastrointestinal salmonellosis. Most of the patients in our study had no or only a few WBC on stool examination. This is different from shigellosis where there may be many WBC or even clumps of WBC in the stool. Occult blood positive stools reflect bowel mucosa inflammation: this was seen in our study. Our findings are similar to studies by Kazemi *et al* (1974) and Huang *et al* (2007). Stool occult blood may be helpful to differentiate *Salmonella* gastroenteritis from non-inflammatory gastroenteritis. However, the diagnostic value of stool occult blood in the diagnosis of *Salmonella* gastroenteritis needs further investigation.

Although salmonellosis is an infectious disease, antimicrobial treatment is generally not recommended for uncomplicated *Salmonella* gastroenteritis (Cleary, 2004). Antimicrobials should be considered in patients aged < 2 or > 50 years, or in patients who have severe gastroenteritis, fever > 72 hours, high fever, suspected complications, or immunocompromised conditions (Darby and Sheorey, 2008). Approximately 80% of the patients in this study were given antimicrobials. Our study confirms the findings of a previous study (Sirinavin and Garner, 2000) that found prescribing antimicrobial therapy for *Salmonella* gut infection had no benefit in terms of duration of fever. It was also found antimicrobials significantly increased the duration of diarrhea. Prescribing antimicrobials for gastrointestinal salmonellosis should therefore be judicious, to prevent complications of the disease, but should avoid the untoward effects of antimicrobials, including the drug's adverse effects and the tendency to prolong *Salmonella* excretion in the stool.

Antimicrobial resistance among NTS has been increasing since the 1990s and is a major problem in several countries (Galanakis *et al*, 2007). Our study found no significant differences in drug sensitivity patterns among the different *Salmonella* serogroups, except for *Salmonella* C which had a higher sensitivity rate to ampicillin. Most *Salmonella* isolates were sensitive to fluoroquinolone and a high percentage were sensitive to Cotrimoxazole. CellaiRustici *et al* (2006) found 49.1% of patients in whom *Salmonella* was isolated, had salmonella resistant to at least one antimicrobial and 13.8% were multidrug (≥3 antimicrobials) resistant. The highest resistance rates were to ampicillin (43.1%) and the lowest rate was to ceftriaxone (0.8%). Kariuki *et al* (2006a) in Kenya found 44.3% of salmonella isolates were resistant to 3 or more antimicrobials, 64% were resistant to ampicillin and 32% were resistant to Cotrimoxazole. There was no resistance to ceftriaxone or ciprofloxacin. Djie-Maletz *et al* (2008) in Ghana found 17% of isolates were resistant to ampicillin and Cotrimoxazole but no isolates were resistant to ciprofloxacin or ceftriaxone. Therefore, if antimicrobials are indicated in cases of salmonellosis, ceftriaxone or a fluoroquinolone should be the drugs of choice.

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