



Characteristics of nontyphoidal *Salmonella* gastroenteritis in Taiwanese children: A 9-year period retrospective medical record review



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ARTICLE INFO

Article history:

Received 17 June 2016

Received in revised form 16 August 2016

Accepted 10 September 2016

Keywords:

Gastroenteritis

Salmonella

Bacteremia

Drug resistance

Cephalosporins

ABSTRACT

Nontyphoidal *Salmonella* is among the most common causes of acute pediatric gastroenteritis in Taiwan. It is important to study antibiotic resistance patterns in nontyphoidal *Salmonella* isolated from children. Therefore, the objective of this study was to investigate the prevalence of serogroups and susceptibility to antimicrobial nontyphoidal *Salmonella* isolated from Taiwanese children with gastroenteritis. A retrospective review of the medical records of patients aged under 18 years with a diagnosis of acute gastroenteritis at a regional hospital located in southern Taiwan from August 2000 to August 2009 was conducted. Patients whose records documented stool cultures positive for nontyphoidal *Salmonella* underwent serogrouping and antimicrobial susceptibility testing. Of the 1938 patients diagnosed with acute gastroenteritis, 100 (5.2%) had nontyphoidal *Salmonella* infections. Most of the cases of nontyphoidal *Salmonella* gastroenteritis occurred during the summer months of July and August. The most common *Salmonella* strains isolated were classified as belonging to serogroup B (51%). Three cases had blood cultures that tested positive for nontyphoidal *Salmonella*, all of which were classified as belonging to serogroup C₂. Isolates from the stool cultures of 23 cases that occurred between 2007 and 2009 were further tested to determine their antimicrobial susceptibility profiles, and 87% of these isolates were sensitive to two common third-generation cephalosporins (cefotaxime and ceftriaxone). In conclusion, the results of this nine-year period medical record review study suggested that although extended-spectrum cephalosporins were more effective than ampicillin and ciprofloxacin in treating childhood nontyphoidal *Salmonella* gastroenteritis, only 87% of isolates were susceptible to these agents. Prevention through proper hygienic practices to minimize potential exposure to nontyphoidal *Salmonella* is clearly a better strategy than treating patients with antibiotics following the incidence of infection.

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Introduction

Nontyphoidal *Salmonella* gastroenteritis is a major cause of diarrheal illness worldwide. It has been estimated that 93.8 million global cases of gastroenteritis due to *Salmonella* occur each year, of which over 85% are foodborne [1]. Nontyphoidal *Salmonella* has also

been identified among the most common causes of acute pediatric gastroenteritis in Taiwan [2].

Generally, symptoms of *Salmonella* gastroenteritis include a sudden onset of vomiting, fever, abdominal cramps, diarrhea, headache, and myalgia. The disease is usually self-limiting, but hospitalization may be required in cases with severe diarrhea. In addition, enteric infections with nontyphoidal *Salmonella* can lead to serious complications such as bacteremia, particularly in the very young, the elderly, and immunocompromised patients [3]. Furthermore, antimicrobial resistance in nontyphoidal *Salmonella* species has become a serious issue worldwide. In the United States, the percentage of nontyphoidal *Salmonella* isolates resistant to ceftriaxone and ciprofloxacin was found to have increased

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from 0.2% to 3.4% and from 0.4% to 2.4% from 1996 to 2009, respectively [4]. Similarly, a study of clinical isolates of nontyphoidal *Salmonella* in southern Taiwan reported that resistance to trimethoprim-sulfamethoxazole increased from 25% in 1989–1992 to 35% in 1993–1996. In that study, ampicillin, chloramphenicol, and trimethoprim-sulfamethoxazole were reported to be no longer the drugs of choice for treatment of serious nontyphoidal *Salmonella* infections [5]. To further investigate antibiotic resistance patterns in nontyphoidal *Salmonella* isolated from Taiwanese children, a medical record review was undertaken. The aim of this study was to investigate the antimicrobial susceptibility and serogrouping of nontyphoidal *Salmonella* isolated from hospitalized children diagnosed with nontyphoidal *Salmonella* gastroenteritis in southern Taiwan.

Materials and methods

Study design and study population

Electronic medical records from August 2000 to August 2009 were retrospectively reviewed to identify patients under 18 years of age who were admitted to the pediatric ward in a regional hospital in southern Taiwan with a diagnosis of acute gastroenteritis. Records from patients with stool cultures positive for nontyphoidal *Salmonella* were identified and further analyzed. The study protocol was reviewed and approved by the Institutional Review Board of the Dalin Tzu Chi Hospital, Buddhist Tzu Chi Medical Foundation, Taiwan (No. B09901010).

Measurements

The age, sex, and duration of hospitalization of and clinical complications in the patients and antimicrobial susceptibility of the isolated nontyphoidal *Salmonella* serogroups were extracted from medical records. Clinical complications were categorized as bacteremia, urinary tract infection, or rotavirus infection.

Salmonella isolation, identification, and antimicrobial susceptibility testing

Salmonella specimens from stool samples were cultured using the standard methods outlined below. Only one isolate per patient was selected for further characterization in this study. The media used were eosin methylene blue (EMB) agar, tryptic soy agar with 5% sheep blood (BAP), and Gram-negative (GN) broth. The API-20E test kit and VITEK 2 rapid identification and susceptibility testing

system (bioMérieux, Lyon, France) were used for the identification of *Salmonella*. *Salmonella* isolates were classified into serogroups based on the Kauffman–White scheme using *Salmonella* O Antisera, *Salmonella* H Antisera, and *Salmonella* Antiserum Vi (Becton Dickinson Diagnostic Systems, Sparks, MD, USA).

The BACTEC 9240 continuous monitoring blood culture system (Becton Dickinson Diagnostic Instrument Systems, Sparks, MD, USA) was used to identify bacteria in the blood cultures of patients. Antibiotic susceptibility testing was performed using an automated VITEK 2 system with Gram-negative bacteria cards (bioMérieux, Lyon, France).

Statistical analysis

Duration of hospitalization was compared between the three age groups (<6 years, 6.0–10.9 years, and 11.0–17.9 years) using a t-test. A two-tailed $p < 0.05$ was considered to be statistically significant.

Results

During the nine-year study period, 1938 cases of acute gastroenteritis in patients under the age of 18 years admitted to the hospital were identified. Of these patients, 100 had stool cultures that tested positive for nontyphoidal *Salmonella*. Thus, the prevalence of nontyphoidal *Salmonella* gastroenteritis was 5.2% (95% confidence interval [CI]: 4.2%–6.2%). Among these 100 patients, 86% were younger than 5 years old, 10% were between 6 and 10 years old, and 4% were between 11 and 18 years old. The male to female ratio was 1.08:1. Although cases of nontyphoidal *Salmonella* gastroenteritis occurred throughout the year, they peaked during the summer months of July (20%) and August (18%) (Fig. 1).

Serogroup B (51%) was the predominant serogroup isolated from stool cultures, followed by C₂ (20%), C₁ (10%), D (10%), E (8%), and G (1%). In addition, three patients tested positive for nontyphoidal *Salmonella* serogroup C₂ bacteremia, and two patients had mixed *Salmonella* and rotavirus infections. Three patients had urinary tract infections; *Escherichia coli* was isolated from two patients and *Klebsiella pneumoniae* was isolates from one patient. There were no cases of bowel perforation and no mortalities identified in our study.

Patients who were under 6 years of age had a significantly longer mean duration of hospitalization than did patients in the two older groups ($p < 0.05$). The mean durations of hospitalization (\pm standard deviation) were 6.7 ± 1.4 days, 4.9 ± 2.6 days, and 4.8 ± 2.7 days in

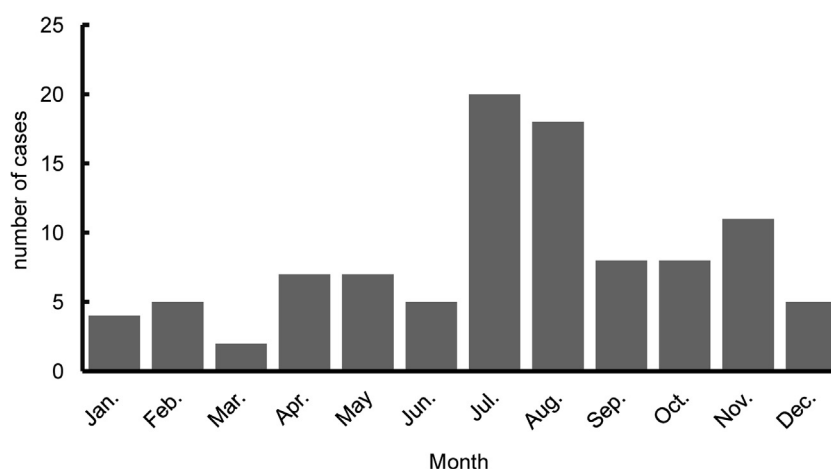


Fig. 1. Distribution of 100 cases of childhood nontyphoidal *Salmonella* gastroenteritis by month.

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