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ORIGINAL ARTICLE

Clinical Manifestations of Nontyphoid Salmonellosis in Children Younger than 2 Years Old—Experiences of a Tertiary Hospital in Southern Taiwan

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Key Words
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Background: Few published studies have explored the clinical manifestations of nontyphoid salmonellosis in children <2 years of age. The aim of this study was to investigate the clinical manifestations, microbiological features, complications, fecal excretion time, and responses to treatment in children <2 years of age with nontyphoid salmonellosis.
Methods: Between January 2005 and December 2009, pediatric patients who were admitted to Kaohsiung Veterans General Hospital with positive cultures for nontyphoid *Salmonella* were enrolled. The following data were recorded: demographic, clinical, and microbiological features, underlying diseases, treatment regimen, complications, responses to treatment, and fecal excretion time. The clinical manifestations were compared between patients <2 years of age and patients >2 years of age.
Results: Of a total 279 enrolled patients, 179 were >2 years of age. Compared with the patients who were ≥2 years of age, patients <2 years of age demonstrated a significantly higher incidence of bloody stool, mixed infection, extraintestinal infection, longer course of antibiotics, longer course of diarrhea after admission, and more days spent in the hospital. The rates of insusceptibility of nontyphoid *Salmonella* to ampicillin, chloramphenicol, trimethoprim/sulfamethoxazole, ceftriaxone, and ciprofloxacin in patients <2 years of age were 37.87%, 29.09%, 23.73%, 3.26%, and 2.25%, respectively. Younger patients were generally more

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susceptible to antibiotics than patients ≥2 years of age, although this result was not statistically significant.
Conclusion: The clinical manifestations of nontyphoid salmonellosis are more severe in younger children <2 years of age than older children. Local susceptibility patterns could serve as a guide for the prescription of antibiotics by clinicians.

1. Introduction

Nontyphoid *Salmonella* is widely spread throughout nature and is the cause of an ongoing worldwide pandemic of foodborne infections.[1] Nontyphoid *Salmonella* can survive in a wide range of hosts and is strongly associated with agricultural products.[2] In Taiwan, nontyphoid *Salmonella* infection is also rampant.[3] Although most cases of gastroenteritis that are caused by nontyphoid *Salmonella* infection are self-limiting. Up to 8% of patients with nontyphoid *Salmonella* gastroenteritis develop bacteremia, and of these 5–10% develop localized infections.[4,5] The risk of developing a nontyphoid *Salmonella* infection and suffering from complications is higher in patients at the extremes of age and those who are immunocompromised, such as HIV-positive patients or those with pathogens that block the reticuloendothelial system. Shimoni et al postulated that there are major differences in the predispositions, clinical presentations, and clinical outcomes of children and adults who are infected with *Salmonella*; nontyphoid *Salmonella* bacteremia is usually secondary to gastroenteritis in children, but it frequently presents as primary bacteremia in adults.[6] The incidence of extraintestinal nontyphoid *Salmonella* infection in Israel demonstrates a U-shaped age-related pattern, with increased risk at the extremes of age, especially in patients <2 years of age or >80 years of age.[7,8] Chiu et al found that being <3 years of age is one of the characteristics of pediatric patients at high risk of having an extraintestinal infection.[9] Chao et al found that being >1 year of age is one of the risk factors associated with intestinal perforation in pediatric patients with nontyphoid *Salmonella* toxic megacolon.[10] Chiu et al further indicated that such complications are regulated through immune-mediated responses, hence young infants are often spared.[11] Based on the aforementioned studies, we hypothesized that there might be different clinical manifestations in children with nontyphoid salmonellosis depending on age. Cross-talk between T and B cells is of fundamental importance for the establishment of a solid acquired immunity to salmonellosis.[12] Children <2 years of age are incapable of mounting a T cell-dependent immune response to polysaccharide macromolecules.[13] However, with the exception of extraintestinal infection, very few published studies have focused on the clinical manifestations in children <2 years of age with nontyphoid salmonellosis.

The aim of this study was to investigate the clinical manifestations, microbiological features, complications, fecal excretion time, and response to treatment in young children <2 years of age with nontyphoid salmonellosis.

2. Material and Methods

2.1. Study population and case definition

Between January 2005 and December 2009, all of the pediatric patients who were admitted to Kaohsiung Veterans General Hospital with positive cultures for nontyphoid *Salmonella* were enrolled in the study. The following data were retrospectively collected and recorded using a standard case report form for each episode of nontyphoid salmonellosis: demographic, clinical, and microbiological features, underlying diseases, treatment regimen, complications, and responses to treatment. The decision to administer antibiotic treatment was at the discretion of the attending physician, with no input from the authors. The criteria for admission and discharge were customary. Patients were admitted if they presented with fever and diarrhea with any symptoms/signs of dehydration or bloody stool. Fever was defined as >37.5°C, as measured by an ear thermometer. Diarrhea was defined as a decrease in consistency (i.e., soft or liquid) and an increase in the frequency of bowel movements to three stools per day, and bloody stool was defined as any stool reported by the parent or guardian as containing blood in one 24-hour period. Patients were discharged when afebrile for >24 hours and when the symptoms/signs of dehydration had resolved. Furthermore, examination of the fecal excretion time was prospectively designed. After thorough explanation to and agreement from the patients' families, repeated stool cultures were collected from some patients on the day of discharge. Then, additional stool cultures were collected every 5–7 days until two consecutive stool cultures were negative. Fecal excretion time was defined as the time from the first positive stool culture through the first of two consecutive negative results.

2.2. Microbiological features

All isolates were cultured and identified according to standard methods, with no major changes regarding the policy for the identification of *Salmonella*. All isolates were serotyped using the Wellcolex color *Salmonella* test (Murex, Dartford, United Kingdom), then confirmed by slide agglutination test using the O antiserum to detect the O antigen (Bacto, Liverpool, NSW, Australia). The antimicrobial susceptibility of the *Salmonella* isolates was examined using the standard disc diffusion method. Resistance to specific antimicrobials was based on reference interpretive standards of the zone diameter.[14]