Research Article

Nontyphoidal Salmonella Gastroenteritis in a Tertiary Children’s Hospital in Southern China: Characteristics and Dietary Considerations

Lu Ren,1 Min Yang,1 Lanlan Geng,1 Peiyu Chen,1 Huan Chen,1 Sitang Gong,1 and Ding-You Li2

1Department of Gastroenterology, Guangzhou Women and Children’s Medical Center, Guangzhou Medical University, Guangzhou 510623, China
2Division of Gastroenterology, Children’s Mercy Kansas City, University of Missouri-Kansas City School of Medicine, Kansas City, MO 64108, USA

Correspondence should be addressed to Min Yang; ymlyxw@hotmail.com

Received 17 November 2017; Accepted 6 February 2018; Published 4 March 2018

Academic Editor: Greger Lindberg

Copyright © 2018 Lu Ren et al. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

Background. Nontyphoidal Salmonella infection is a common cause for acute bacterial gastroenteritis in children in China 

The aim of this study was to characterize nontyphoidal Salmonella gastroenteritis in a tertiary children’s hospital and evaluate clinical presentation, lactose intolerance, and food allergies in children with prolonged nontyphoidal Salmonella gastroenteritis.

Methods. A retrospective case-series analysis was carried out in a tertiary children’s hospital in Guangzhou, China. We included all infants and children who were diagnosed with nontyphoidal Salmonella gastroenteritis between 1 January 2014 and 31 December 2016. Patients’ clinical features, feeding patterns, laboratory tests, and treatment outcomes were reviewed.

Results. A total of 142 infants and children were diagnosed with nontyphoidal Salmonella gastroenteritis. 52.1% of cases occurred in infants ≤12 months of age and the majority (89.4%) in children younger than 3 years old. The most common symptoms were diarrhea (100%), fever (62%), and vomiting (18.3%). Salmonella Typhimurium was the predominant serotype, accounting for 82.4%. 91.5% of patients were treated with antibiotics. Forty-one (28.9%) and 9 (6.3%) children improved with a lactose-free diet and hypoallergenic formula, respectively, when diarrhea persisted for more than a week.

Conclusions. Salmonella Typhimurium was the predominant serotype. Most patients with nontyphoidal Salmonella gastroenteritis were younger than 3 years old. Lactose intolerance occurred frequently in children with nontyphoidal Salmonella gastroenteritis and dietary modification should be considered when diarrhea is persistent and prolonged.

1. Introduction

Nontyphoidal Salmonella infection is a common cause for acute bacterial gastroenteritis in children in China [1, 2]. The main symptoms of nontyphoidal Salmonella gastroenteritis in infants and children include acute onset of diarrhea, vomiting, fever, abdominal pain, and irritability. Nontyphoidal Salmonella gastroenteritis is mostly a self-limiting disease and resolves within one week in healthy children [3]. However, disease course may be prolonged in children with secondary lactase deficiency or food allergies [4–6]. There has been no study to assess the prevalence of lactose intolerance or food allergies in children with nontyphoidal Salmonella gastroenteritis. The aim of this study was to characterize nontyphoidal Salmonella gastroenteritis in a tertiary children’s hospital in southern China and evaluate clinical presentation,
lactose intolerance, and food allergies in children with prolonged nontyphoidal *Salmonella* gastroenteritis.

2. Methods

A retrospective case-series analysis was carried out in a tertiary children’s hospital in Guangzhou, China. We reviewed all cases with stool culture performed and included all infants and children who were diagnosed with nontyphoidal *Salmonella* gastroenteritis between 1 January 2014 and 31 December 2016. Patients’ clinical features, feeding patterns, laboratory tests, and treatment outcomes were reviewed. All children underwent routine evaluation including a complete blood count, electrolytes, C-reactive protein (CRP), blood culture for bacteria and fungus, stool culture for bacteria, and stool viral antigen tests (rotavirus and adenovirus). All laboratory works were performed at our hospital laboratory, which is a standard tertiary hospital facility. The diagnosis of nontyphoidal *Salmonella* gastroenteritis was confirmed by stool culture. *Salmonella* isolates from stool samples were serotyped per standard protocol.

Treatments of children with nontyphoidal *Salmonella* gastroenteritis include general supportive care and antibiotic therapy if indicated [3]. Choices of antibiotics were guided by local antimicrobial resistance pattern and/or antimicrobial susceptibility testing. For patients with diarrhea that lasted for ≥7 days, stools were tested for carbohydrate malabsorption, and a lactose-free diet or formula was initiated if the stool reducing substance was positive and stool pH was <5.5 [7]. For children with confirmed or clinically suspected food allergies, hypoallergenic formula/diet would be initiated.

The institutional ethics committee of Guangzhou Women and Children’s Medical Center approved this study protocol.

3. Results

There were 7379 stool cultures performed between 1 January 2014 and 31 December 2016. As shown in Table 1, a total of 142 infants and children were diagnosed with nontyphoidal *Salmonella* gastroenteritis, with male predominance. About half (52.1%) of them presented at <12 months of age. All infants presented with diarrhea 2–30 times/day with average 8 times/day. Most patients had mucus and blood in stools. Other common presenting symptoms included fever, vomiting, abdominal pain, bloating/distention, and irritability. Laboratory tests showed that most patients (89.4%) had elevated CRP. Leukocytosis, thrombocytosis, and anemia occurred in 42.3%, 40.8%, and 36.6% of children, respectively. Microscopic stool exam showed increased WBC and RBC in 62.7% and 33.1% of patients, respectively. Stool occult blood was positive in the majority (78.2%) of children.

Stool culture was positive for nontyphoidal *Salmonella* in all children. *Salmonella* Typhimurium was the predominant serotype, accounting for 82.4% of isolates. Other minor serotypes included Enteritidis, Saintpaul, Bovis mortificans, Thompson, Paratyphi B, and A.

| Table 1: Basic characteristics, clinical features, and laboratory tests and treatments in 142 infants and children with nontyphoidal *Salmonella* gastroenteritis. |
|---|
| Age |
| <12 months | 74 (52.1%) |
| 1–3 years | 53 (37.3%) |
| ≥3 years | 15 (10.6%) |
| Sex, M/F | 64.1%/35.9% |
| Disease duration at presentation |
| <2 weeks | 100 (70.4%) |
| 2–4 weeks | 31 (21.8%) |
| ≥4 weeks | 11 (7.8%) |
| Prior illness |
| Respiratory infection | 20 (14.1%) |
| Hand, foot, and mouth disease | 6 (4.2%) |
| Symptoms |
| Diarrhea | 142 (100%) |
| Mucus in stool | 85 (59.9%) |
| Blood in stool | 76 (53.5%) |
| Fever (T ≥ 38°C) | 88 (62.0%) |
| Nausea and vomiting | 26 (18.3%) |
| Bloating/distention | 10 (7.0%) |
| Abdominal pain | 10 (7.0%) |
| Irritability | 5 (3.5%) |
| Laboratory studies |
| Leukocytosis (≥12 × 10⁹/L) | 60 (42.3%) |
| Thrombocytosis (≥300 × 10⁹/L) | 58 (40.8%) |
| Anemia (HB < 110 g/L) | 52 (36.6%) |
| CRP (≥1 mg/L) | 127 (89.4%) |
| Stool WBC ≥ (+) | 89 (62.7%) |
| Stool RBC ≥ (+++) | 47 (33.1%) |
| Stool occult blood (+) | 111 (78.2%) |
| Stool culture: positive Salmonella | 142 (100%) |
| *Salmonella* serotype |
| Typhimurium | 117 (82.4%) |
| Enteritidis | 12 (8.5%) |
| Saintpaul | 6 (4.2%) |
| bovis mortificans | 2 (1.4%) |
| Thompson | 2 (1.4%) |
| Paratyphi B | 2 (1.4%) |
| Paratyphi A | 1 (0.7%) |
| Treatments |
| Antibiotics |
| Oral antibiotics | 26 (18.3%) |
| IV antibiotics | 104 (73.2%) |
| Lactose-free formula/diet | 41 (28.9%) |
| Hypoallergenic formula | 9 (6.3%) |
| Clinical resolution after treatment |
| <2 weeks | 129 (90.8%) |
| 2–4 weeks | 9 (6.3%) |
| >4 weeks | 4 (2.8%) |
Twenty-six children had prior infections including 20 (14.1%) with respiratory infection and 6 (4.2%) with hand, foot, and mouth disease.

All patients received supportive care including oral rehydration, probiotics (Lactobacillus/Bifidobacterium and/or Saccharomyces boulardii), and montmorillonite. 91.5% of patients were treated with antibiotics, with 73.2% administered intravenously. Forty-one (28.9%) children improved with lactose-free formula and/or diet when diarrhea persisted for more than a week and stool testing was positive for carbohydrate malabsorption. Five patients were tested positive for serum allergen-specific IgE (sIgE), and 4 patients were highly suspected of food allergy based on clinical symptoms although sIgE was negative. All 9 patients (6.3%) improved with hypoallergenic formula (extensively hydrolyzed or amino-acid formula).

All children had clinical resolution with majority (90.8%) within 2 weeks. No significant adverse reactions were observed.

4. Discussion

Nontyphoidal Salmonella is a major enteric pathogen for acute bacterial gastroenteritis in children in China [1, 8, 9]. In our study, about half of cases occurred in infants ≤12 months of age and the majority (89.4%) in children younger than 3 years old, consistent with other reports [1, 2]. The main symptoms in our cohort were diarrhea, fever, and vomiting. Most infants and children had mucus and/or blood in stools. Laboratory study revealed that the majority (89.4%) of patients had elevated CRP while leukocytosis, thrombocytosis, and anemia occurred in less than 50% of cases.

In our study, nontyphoidal Salmonella Typhimurium was the predominant (82.4%) serotype, followed distantly by Enteritidis (8.5%), Saintpaul (4.2%), bovis morbillicans (1.4%), Thompson (1.4%), Paratyphi B (1.4%), and Paratyphi A (0.7%). Our results were different from those reported by others in China. Ran et al. reported that serotype Enteritidis (31%) and serotype Typhimurium (26%) were the most common, and Li et al. found that Enteritidis (38.9%) and Typhimurium (29.7%) were the most common serotypes [1, 9]. The inconsistency may be due to the changing epidemiological trend, the regional variation, and the specific patient population. As a tertiary children’s center, the patients in this study were referred from surrounding hospitals due to persistent symptoms in spite of supportive care and other treatments. It would be interesting to investigate the nontyphoidal Salmonella serotype in those surrounding hospitals.

Antibiotic therapy is generally not recommended for uncomplicated gastroenteritis in healthy children with nontyphoidal Salmonella infection [3]. In our study, the majority (91.5%) of infants and children received oral or intravenous antibiotics. This is likely due to our specific patient population referred from surrounding hospitals where initial supportive care failed. With appropriate antibiotic therapy and other supportive care, the majority (90.8%) of our patients had clinic resolution within 2 weeks.

Early studies suggest that secondary lactose intolerance and food allergies occur in children with acute infectious diarrhea, and lactose-free or hypoallergenic formulas improve symptoms [4, 5, 10]. However, there has been no any reports of the prevalence of lactose intolerance or food allergies in children with nontyphoidal Salmonella infection. Our study showed that 28.9% of children had significant symptom improvement with a lactose-free formula or diet, indicating that secondary lactase deficiency occurs frequently in children with nontyphoidal Salmonella gastroenteritis. Only 6.3% had confirmed or suspected food allergies. Dietary modification should be considered when diarrhea is persistent and prolonged.

The major strength of this study is that this is the first report of relatively common secondary lactase deficiency in children with nontyphoidal Salmonella gastroenteritis. However, this study has weaknesses and limitations. This is a retrospective case review, and a standard lactose breath test was not used to diagnose lactose intolerance. A larger epidemiology study would be necessary to assess the true prevalence of lactose intolerance and food allergies in children with nontyphoidal Salmonella infection.

5. Conclusions

This study demonstrates that Salmonella Typhimurium was the predominant serotype. Most patients with nontyphoidal Salmonella gastroenteritis are younger than 3 years old, and the main symptoms are diarrhea, fever, and vomiting. Lactose intolerance occurs frequently in children with nontyphoidal Salmonella gastroenteritis. Dietary modification should be considered when diarrhea is persistent and prolonged.

Data Availability

The data supporting the current findings are not publicly available since the database is currently not anonymous and contains all the patients’ names. However, it will be available upon request.

Ethical Approval

This study was approved by the Institutional Ethics Committee of the Guangzhou Women and Children’s Medical Center.

Consent

Written informed consent was given by the caregiver of children for their clinical records to be used in this study.

Disclosure

The data in this manuscript was presented as a poster in two conferences: The 17th Congress of Gastroenterology China, Xian, China, 14–16 September 2017: Lu Ren, Min Yang, and Lanlan Geng. Lactose intolerance in children with nontyphoidal Salmonella gastroenteritis is a tertiary children’s hospital in southern China. Journal of Digestive Disease 2017; 18 (Suppl. 1): 122. The North American Society for Pediatric Gastroenterology, Hepatology and Nutrition Annual Meeting, Las Vegas, USA, November 1–4, 2017: Min...
Yang, Lu Ren, Sitang Gong, and Ding-You Li. Lactose intolerance in children with nontyphoidal Salmonella gastroenteritis in a tertiary children’s hospital in southern China. Journal of Pediatric Gastroenterology and Nutrition, 2017; 65 (Suppl. 2):S73.

Conflicts of Interest

No competing interests associated with this manuscript.

Authors’ Contributions

Lu Ren and Min Yang were responsible for the study concept and design, acquisition of data, analysis and interpretation of data, and drafting of the manuscript. Lanlan Geng, Peiyu Chen, and Huan Chen were responsible for the acquisition of data. Ding-You Li and Sitang Gong were responsible for the critical revision of the manuscript for important intellectual content and study supervision. All authors read and approved the final manuscript.

Acknowledgments

The authors thank Dr. Craig Friesen from Children’s Mercy Hospital for critical reading of the manuscript.

References

[1] Y. Li, X. Xie, X. Xu et al., “Nontyphoidal salmonella infection in children with acute gastroenteritis: prevalence, serotypes, and antimicrobial resistance in Shanghai, China,” Foodborne Pathogens and Disease, vol. 11, no. 3, pp. 200–206, 2014.

[2] Y. T. Hung, C. J. Lay, C. L. Wang, and M. Koo, “Characteristics of nontyphoidal Salmonella gastroenteritis in Taiwanese children: A 9-year period retrospective medical record review,” Journal of Infection and Public Health, vol. 10, no. 5, pp. 518–521, 2017.

[3] F. J. Bula-Rudas, M. H. Rathore, and N. F. Maraqa, “Salmonella infections in childhood,” Advances in Pediatrics, vol. 62, no. 1, pp. 29–58, 2015.

[4] G. Capano, S. Guandalini, A. Guarino et al., “Enteric infections, cow’s milk intolerance and parenteral infections in 118 consecutive cases of acute diarrhoea in children,” European Journal of Pediatrics, vol. 142, no. 4, pp. 281–285, 1984.

[5] R. Fox, C. L. Leen, E. M. Dunbar, M. E. Ellis, and B. K. Mandal, “Acute gastroenteritis in infants under 6 months old,” Archives of Disease in Childhood, vol. 65, no. 9, pp. 936–938, 1990.

[6] P. Usai-Satta, M. Scarpa, F. Oppia, and F. Cabras, “Lactose malabsorption and intolerance: what should be the best clinical management?,” World Journal of Gastrointestinal Pharmacology and Therapeutics, vol. 3, no. 3, pp. 29–33, 2012.

[7] R. Nyeko, I. Kalyesubula, E. Mworazi, and H. Bachou, “Lactose intolerance among severely malnourished children with diarrhoea admitted to the nutrition unit, Mulago hospital, Uganda,” BMC Pediatrics, vol. 10, no. 1, p. 31, 2010.

[8] J. Yu, H. Jing, S. Lai et al., “Etiology of diarrhea among children under the age five in China: results from a five-year surveillance,” The Journal of Infection, vol. 71, no. 1, pp. 19–27, 2015.

[9] L. Ran, S. Wu, Y. Gao et al., “Laboratory-based surveillance of nontyphoidal Salmonella infections in China,” Foodborne Pathogens and Disease, vol. 8, no. 8, pp. 921–927, 2011.

[10] H. Szajewska, M. Kantecki, P. Albrecht, and J. Antoniewicz, “Carbohydrate intolerance after acute gastroenteritis—a disappearing problem in Polish children,” Acta Paediatrica, vol. 86, no. 4, pp. 347–350, 1997.