Two Peculiar Issues on Pediatric Enteric Infections in Taiwan: *Pseudomonas aeruginosa* and Polymicrobial Infections

Shih-Yen Chen¹,², Chih-Hsien Chuang²,³, Cheng-Hsun Chiu⁴*

¹Division of Pediatric Gastroenterology, Department of Pediatrics, Chang Gung Children’s Hospital, Chang Gung University College of Medicine, Taoyuan, Taiwan
²Graduate Institute of Clinical Medical Sciences, Chang Gung University College of Medicine, Taoyuan, Taiwan
³St Paul’s Hospital, Taoyuan, Taiwan
⁴Division of Pediatric Infectious Diseases, Department of Pediatrics, Chang Gung Children’s Hospital, Chang Gung University College of Medicine, Taoyuan, Taiwan

Acute gastroenteritis (AGE) is undoubtedly one of the most prevalent infectious diseases worldwide. In this issue of the journal, two articles of enteric infections are published: one by Cheng et al¹ on the clinical significance in healthy children with *Pseudomonas aeruginosa* identified in the stool, and the other by Lan et al² on concomitant enteric infections by rotavirus and *Salmonella*. These investigations again highlighted two important features of enteric infections in children in Taiwan, as have been previously documented.³⁻⁶

Variable conditions associated with enteric infections differ with the changes in environment, seasonal, public health circumstances, and the two most important factors are the circulating enteric pathogens and host immunity. The confinement of enteric infections depends on a reliable epidemiological information with regional circulating pathogens, molecular microbiological data, drug resistance, and furthermore a complete phylogenetic or evolutionary analysis of enteric viruses and bacteria providing a sufficient information for the development of vaccination and trials. The major causative agents for enteric infections in children include bacteria, viruses, fungi, and parasites with the most two threatening organisms being bacteria and viruses.⁷ Until now, well developed and developing culture systems for emerging and resistant strains of bacteria have quickened our comprehensive understanding of the pathogenesis for enteric bacteria. However, the impact of changing pathogenicity and increasing drug resistance against currently available antibiotics imposed new challenges and leads the way for more advanced and efficient molecular biological studies. Viruses causing AGE had been studied for decades since the viral agents including rotavirus, norovirus, and other enteric viral pathogens were identified by electron microscopy and reverse transcription polymerase chain reaction (RT-PCR).⁸ Current research on enteric viral infection include the identification of new or emerging agents, the molecular epidemiology and surveillance of circulating viruses, and the containment of rotavirus infection by effective vaccines.

*P. aeruginosa* was not previously recognized as an enteric infection agent, and rarely causing life-threatening events, except in patients with immunocompromised status, cystic fibrosis, and hematological, malignant, or other chronic diseases. *P. aeruginosa* is also a common nosocomial pathogen. However, in Taiwan, *P. aeruginosa* sepsis had been documented to occur in the community setting, and...
usually affects infants without underlying diseases. Community-acquired \( P. \) aeruginosa infection could result in intestinal perforation, peritonitis and even fatality in previously healthy infants, presumably due to the initial administration of an inappropriate antibiotic regimen.\(^5\)\(^,\)\(^9\) Cheng et al\(^1\) in this issue of journal reported 45 previously healthy children under 15 years of age having \( P. \) aeruginosa in the stool; seven of them developed complications, including three sepsis, and two deaths. A left shift in the hemogram, elevated C-reactive protein (CRP), anemia, and hypoalbuminemia were warning signs for the development of severe complications. A drawback of the study is the limited number of cases enrolled, and thus further prospective studies involving more cases are needed to delineate the clinical features as well as uncover the underlying mechanism of \( P. \) aeruginosa enteric infections in children in Taiwan. On the other hand, 20 patients (44%) did not have gastrointestinal problems on admission. Among them, 17 were treated with antibiotics before they had diarrhea. Was their diarrhea antibiotic-associated? Was their diarrhea truly caused by \( P. \) aeruginosa? Could there be any other concomitant or predisposing infections? This was again a question left for further investigations.

The ecology and interaction of enteric microbes in the human gut is an inevitable issue when discussing enteric infections. Another article in this issue of the journal reported concomitant rotavirus and \( Salmonella \) infections in children,\(^2\) showing that among 895 cases studied, 33 (3.7%) were concomitantly infected by the two enteric pathogens. An important finding is that patients with polymicrobial infections had higher CRP values as well as a higher incidence of hypokalemia than was solitarily infected by rotavirus or \( Salmonella \). However, the methodology used in this study regarding sampling and case selection may have biased at least in part the results and discussion of this study. It is impossible to have all pathogens identified in all hospitalized patients with AGE; perhaps the data showed just part of what the patients admitted under the diagnosis of AGE had. Furthermore, although the application of enzyme immunoassay for the identification of rotavirus is acceptable in the clinical setting, while for epidemiological studies, molecular biological methods such as RT-PCR and PCR to detect enteric viruses will provide more sensitive and comprehensive information not only in virus identification but also in the genetic and evolutionary analysis of the circulating viruses. Such studies are particularly important in the post-vaccine era in Taiwan.\(^10\) Having said that, it is consolable that in Taiwan, young investigators have started a different spectrum in studying enteric infections by extending their view from solely clinical manifestations or laboratory analysis to something that is new and novel.

In conclusion, Taiwan is an island country with a high density of population. The fighting to control enteric infection is a never-ending challenge. The spread of enteric infectious diseases might be controlled by the improvement of hygiene to some extent but it is always not enough when facing new and emerging challenges such as \( P. \) aeruginosa or polymicrobial infections. In view of the high disease burden, more efforts should be focused on the understanding of pathogenesis of emerging and polymicrobial enteric infection, the establishment of comprehensive consensus in clinical treatment, and the impact of the rotavirus vaccines on the overall epidemiology of enteric infections.

References