

Viral gastroenteritis



Ruth F Bishop

Acute gastroenteritis is a common illness occurring in the neonatal period and throughout life in humans and animals. Infections with viral, bacterial or protozoal pathogens can precipitate the rapid onset of life-threatening symptoms, including diarrhoea, vomiting, fever and dehydration due to fluid and electrolyte loss.

Although the infectious nature of gastroenteritis was clear, an enteric pathogen could not be identified prior to 1972 in the majority of cases. Viral infections were suspected, but could not be proven. Using electron microscopy, virus particles had been described in 1963 as a cause of episodes of diarrhoea in infant mice and in 1967 as a cause of diarrhoea in calves. The application of electron microscopy to the examination of diarrhoeal faecal specimens from humans revealed two 'new' viruses. Norwalk virus, a member of the *Caliciviridae* family, was identified in 1972 by immune electron microscopy of diarrhoeal specimens from human volunteers infected with faecal filtrate from an outbreak of gastroenteritis in the USA. Rotavirus particles were first identified by electron microscopy in 1973 in duodenal mucosa and diarrhoeal faecal specimens collected from children admitted to the Royal Children's Hospital in Melbourne for treatment of severe gastroenteritis.

Research over the past 40 years, taking advantage of technical advances in electron microscopy, enzyme-linked immunoassays and molecular-based techniques, has provided an understanding of the role of these and other viruses as causative agents of gastroenteritis in animals and humans. The magnitude and severity of infections with rotavirus in children has led to the successful development of two safe and effective oral rotavirus vaccines for the prevention of acute gastroenteritis. Clinical trials have shown that vaccination is estimated to prevent approximately 70% of rotavirus gastroenteritis of any severity, and 85–100% of cases of severe gastroenteritis in immunised children. In Australia, rotavirus vaccines have been provided free to all infants under the National Immunisation Program from July 2007. In the pre-vaccine era, there were approximately 10,000 hospitalisations, 22,000 emergency room visits and 115,000 general practice consultations for rotavirus annually in Australian children less than five years of age. Indigenous Australian children aged 0–2 years of age had approximately five times the hospitalisation rates due to rotavirus infection. The vaccination program has been successful in decreasing the disease morbidity in Australia, and morbidity and mortality in all countries who have adopted rotavirus vaccines worldwide. Long-term surveillance of rotavirus is necessary to monitor changes in genotype distribution to ensure vaccine programs remain effective.

Noroviruses cause sporadic disease in children and adults, and are known as a common cause of diarrhoeal outbreaks in a range of settings including hospitals, nursing homes, cruise ships and



Carl D Kirkwood

schools. The economic damage as a result of such outbreaks probably exceeds the clinical damage. Recent norovirus research shows a single genetic lineage of these viruses as the major cause of pandemic and epidemic viral gastroenteritis worldwide. Development of the first vaccines using virus-like particles has encouraged hope of the eventual development of an effective vaccine.

Comprehensive surveys of viruses identified in faecal samples from humans and animals with acute diarrhoea present a complex picture. The development of molecular techniques has greatly improved our understanding of viral disease pathogenesis, and has led to the identification of several other viruses implicated in the aetiology of acute diarrhoea in domestic and farm animals, avian species and man. These viral enteric pathogens include enteric adenoviruses (40 and 41), astroviruses, picornaviruses and bocaviruses. Neonatal animals are vulnerable to viral enteritis partly as a consequence of group rearing and early weaning. The most significant pathogens vary between animal species, with Group A rotaviruses a common cause of gastroenteritis in all mammals and birds. Generally the dominant types differ between animal species. Coronaviruses adapted to growth in different animal species appear to be the next most common symptomatic cause. Noroviruses are pathogens of pigs; however, comprehensive molecular studies have not yet been applied to understanding the aetiology in animals. Understanding the contribution of other viruses and strategies to control diarrhoeal disease remains a challenge for the future.

The subject of this issue of *Microbiology Australia* is very topical in view of the recent WHO recommendation of universal rotavirus vaccination for all children worldwide. In addition, the emerging significance of other enteric pathogens of humans and animals requires ongoing and continued investigation.

Biographies

Ruth Bishop is an Honorary Research Fellow, Murdoch Children's Research Institute, Melbourne, and an Honorary Professorial Fellow, Department of Paediatrics, University of Melbourne. She is a recent recipient of Thailand's 2011 Prince Mahidol Award for contributions to the discovery of rotavirus and subsequent vaccine development.

Carl Kirkwood is Group Leader of the Enteric Virus Research Group at the Murdoch Children's Research Institute, Melbourne, and Associate Professor in the Department of Microbiology, La Trobe University. He is director of the WHO Collaborating Centre for Child Health (rotavirus research) and Regional Reference Laboratory. Nationally, he heads the Australian Rotavirus Surveillance Program and plays a lead role in the development of the Australian neonatal rotavirus vaccine. His research interests include understanding the role of viruses in childhood diseases of the gastrointestinal tract.