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Viral agents of acute gastroenteritis in hospitalized children in Greece

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Abstract

A 6-year study of stool samples from 4604 children hospitalized for acute gastroenteritis was conducted to investigate the role of enteric viruses as a cause of gastroenteritis in north-west Greece. Rotaviruses, noroviruses, adenoviruses and astroviruses were detected in 21.35%, 4%, 3.5% and 2.35%, respectively, by enzyme immunoassays and molecular techniques. Molecular techniques enhanced overall diagnostic efficacy by 2.5%, and by c. 10% each for rotavirus and adenovirus. Rotavirus was the leading cause of viral gastroenteritis, usually associated with severe illness. Mixed infections were found in 4.4% of positive specimens, and rotavirus plus astrovirus represented the most frequent co-infection (55.5%). This first study on the epidemiology of viral gastroenteritis in Greece shows that recent advances in the diagnosis of viral enteropathogens may have only marginal effects on overall diagnostic efficacy, and thus the impact of viral agents causing sporadic gastroenteritis in public health cannot be fully evaluated.

Keywords: Adenovirus, astrovirus, child, gastroenteritis, Greece, norovirus, rotavirus

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seasonal distribution of admissions, and no peak of viral detection rate was found, excluding the aforementioned season. Table I depicts the frequency of viral isolation with EIA. As noted, group A rotavirus was responsible for the majority of cases, followed, in order of frequency, by noroviruses, adenoviruses, and astroviruses. The adenovirus strains detected belonged to subgenus F (69.8%), subgenus C (16%) and subgenus A (14.2%).

Molecular testing clarified an additional 110 positive samples: 92 rotavirus cases and 18 adenovirus cases. Negative results were found in all control group samples.

To our knowledge, this is the first extended report on the epidemiology of viral gastroenteritis in hospitalized children under 5 years of age in Greece. In a 1999 Athens study of children with diarrhoea [6], the overall incidence of viral gastroenteritis was significantly lower (12.5%). This could be attributed to the fact that different viral detection methods had been used and fewer viral pathogens had been investigated.

By contrast, the percentage of virus-positive cases was similar [7,8] or lower [9–12] to that reported in other studies. Many of these studies [10–12] were performed during the winter season, which is the peak season of viral diarrhoea. Limiting our study to this period, the percentage of viral enteric pathogens would rise to 60% (746 virus-positive samples out of 1243 admissions). Moreover, investigation of other enteric viruses, such as enteroviruses, sapoviruses, toroviruses, picornaviruses and coronaviruses would probably increase the overall proportion of viral gastroenteritis.

As reported worldwide [9,12–14], group A rotavirus was the most frequent viral agent detected in children from north-west Greece. Infection severity (dehydration, fever >38 °C, diarrhoea, vomiting and duration of symptoms) was greater in rotavirus cases than in those associated with other viruses [3,4,9]. As previously suggested, our results confirm norovirus as the second commonest viral agent among hospitalized children with acute gastroenteritis [10–12]. Astrovirus and adenovirus infection rates were also comparable [9,13,15]. Although enteric adenovirus types 40 and 41 predominated, non-enteric subgenera (A and C) were also causally implicated [8]. As the detection of norovirus and astrovirus infections was performed only by EIA, one can speculate that their incidence may have been underestimated.

The most important observation, as with other reports, remains that, in the majority of cases, despite the use of molecular techniques, no pathogen was isolated: this implies that hitherto unknown enteropathogenic viruses/bacteria

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**TABLE 1. Viral enteropathogens detected by enzyme immunoassay**

| Pathogen   | Mono-infection Cases (% of total) | Co-infection | Viral-viral co-infections | Viral–bacterial co-infections |
|------------|----------------------------------|--------------|---------------------------|------------------------------|
| Rotavirus  | 941 (20.4)                       |              | 32 viral–viral (adenovirus, 10; astrovirus, 20; aden-astrovirus, 2) | 10 viral–bacterial (Salmonella spp., 3; Yersinia enterocolitica, 2; Campylobacter jejuni, 5) |
| Adenoviruses | 142 (3.1)                      |              | 16 viral–viral (rotavirus, 10; astrovirus, 4; rota-astrovirus, 2) | 4 viral–bacterial (all Salmonella spp.) |
| Astroviruses | 70 (1.5)                      |              | 26 viral–viral (rotavirus, 20; adenovirus, 4; rota-adenovirus, 2) | 12 viral–bacterial (all Salmonella spp.) |
| Noroviruses | 185 (4)                      |              | None                      | None |

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![FIG. 1. Annual seasonality of enteric viruses in north-west Greece.](image-url)
may exist, or that our current diagnostic efficacy in acute gastroenteritis may actually still be low. The addition of molecular techniques resulted in an increase in detection of rotavirus and adenovirus cases by c. 10%, increasing the overall diagnostic efficacy by 2.5%.

There are limited data available on co-infections in gastroenteritis cases, and the rate of such infections varies widely in the literature. In our study, the rate of co-infections (4.4%) was lower than reported in other European studies [7,12–14]. Rotavirus plus astrovirus (55.5%) represented the most frequent co-infection [7,8,12,14].

In conclusion, although it has been demonstrated that rotavirus plays a significant role in hospitalized children with diarrhoea in Greece, the potential cost-effectiveness of routine vaccination cannot be speculated upon. Molecular techniques for detecting viral enteropathogens marginally enhanced diagnostic sensitivity in this patient series, and the majority of cases remained of unknown cause. One can suggest, however, that routine testing for norovirus may be warranted, it being the second most frequent viral causative agent, and that the presence of dual infections also warrants further epidemiological and pathogenetic discussion.

Although implementation of routine testing for viral agents causing acute diarrhoea may have an impact on the public health burden of viral gastroenteritis, there is still a long way to go to achieve a satisfactory diagnostic yield.

Transparency Declaration

The authors declare that they have no competing interests.

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