Epidemiology of Rotavirus Diarrhea in the Highlands of Papua, New Guinea, in 1979, as Revealed by Electrophoresis of Genome RNA

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Results of gel electrophoresis of rotavirus genome RNA from feces of children in two provinces in Papua, New Guinea, suggest that the epidemiology of rotavirus infection in small communities with a total population of 3,000 may differ from that in urban or closely settled rural areas.

Rotaviruses are an important cause of acute diarrhea in young children in developing and developed countries of the world (12). The epidemiology of rotavirus infection has been mostly studied in closely populated areas, both urban and rural (1, 2, 8, 9). Few studies have been carried out in small populations leading relatively isolated lives. Linhares et al. (7) studied an epidemic of diarrheal disease due to rotavirus in northern Brazil and concluded that the epidemiological pattern of rotavirus infection in isolated populations “may be atypical of those in urban areas.” The results of a survey of rotavirus infection in children in two areas of the Highlands in Papua, New Guinea, support this conclusion.

During April to July 1979, a survey for rotavirus was conducted in children less than 2 years of age with acute diarrhea of less than 96 h duration admitted to Goroka Hospital or Kundiawa Hospital in the Highlands of Papua, New Guinea. Stool specimens were obtained from 50 children admitted to Goroka Hospital and 43 children admitted to Kundiawa Hospital. Electron microscopic examination of stools revealed rotavirus particles in 86% of children from Kundiawa and 50% of children from Goroka. These recovery rates were regarded as very high, and it was suspected that the survey might have coincided with an epidemic of rotavirus diarrhea in Kundiawa (11). Strains of rotavirus stored after the original survey were subjected to electrophoresis of genome RNA to obtain detailed epidemiological information about rotavirus strains present in the two communities (9).

Twenty-four stool specimens from children admitted to Goroka Hospital and 33 specimens from children admitted to Kundiawa Hospital were available for analysis. All contained rotavirus particles in quantities previously graded as 1 to 4+ by electron microscopy. Approximately 1 g of each stool was homogenized, treated with sodium dodecyl sulfate, and deproteinized before electrophoresis. The techniques for RNA extraction and gel electrophoresis are described elsewhere (9). Comparisons of different strains were made, when necessary, by coelectrophoresis.

The RNA patterns of rotaviruses from Kundiawa and Goroka are shown in Fig. 1. The electropherotypes are designated PA to PF for convenience. PA, PB, and PC are “short” patterns, and PD, PE, and PF are “long” patterns, based on differences in the mobilities of the 10th and 11th segments in their genomes. All 33 specimens from Kundiawa yielded an electropherotype designated as PA, with a short RNA pattern. Coelectrophoresis of these visually similar electropherotypes showed them to be identical. Of the 24 specimens from Goroka, 11 showed the same electropherotype (PA), and this was again confirmed by coelectrophoresis. The remaining 13 specimens from Goroka were identified as PB (one), PC (one), PD (four), PE (six), or PF (one). Electropherotypes PB and PC closely resembled PA, but PB had a faint additional band between segments 4 and 5, and PC had two extra bands, one between segments 5 and 6 and another just below segment 9. Results of coelectrophoresis with PA are shown in Fig. 2. All 11 segments in PA comigrated with the corresponding segments in PB and PC, leaving the “extra” bands in their respective positions. Electropherotypes PD, PE, and PF were clearly different on gel patterns alone and did not require coelectrophoresis.

The results show that one electropherotype of rotavirus (PA) was responsible for infection of all children examined in Kundiawa Hospital during April to July 1979. The same strain was
also responsible for infection in 11 of the 24 children examined at Goroka Hospital. Two other children in Goroka were infected with closely related electropherotypes possessing additional bands. We are not sure whether or not these bands are rotaviral in origin, as the RNA was not extracted from purified virions but from whole feces. Other investigators have observed the presence of extra bands in certain specimens (8, 10). PA possessed a short gel pattern that corresponds to subgroup 1 of the human rotavirus (6, 9). The three other electropherotypes present in a total of 11 children examined in Goroka all possessed long gel patterns that correspond to subgroup 2 of the human rotavirus (6, 9).

It is interesting to speculate on the different epidemiological patterns of infection detected in these two neighboring areas of Papua, New Guinea. Kundiawa and Goroka are separated by a distance of 100 km, and travel between the two towns is quite common. However, the populations sampled by the two hospitals are different and have different styles of living. Kundiawa is the major center for the Simbu province in the Highlands. The hospital admits children from widely dispersed areas of the province. The province has an estimated population of 3,000, and the inhabitants live in scattered and remote villages. Goroka is an Eastern Highland province. This is one of the most densely populated areas in Papua, New Guinea, containing approximately 11,000 people, many of whom live in an "urban" environment surrounding Goroka.

The results from Goroka display a pattern that is epidemiologically similar to surveys in Melbourne, Australia, (9), Alice Springs, Australia (10), New Zealand (1), and Mexico (2), i.e., there was a mixed population of strains with one predominant electropherotype. Rotavirus infection is endemic in all these areas, where the population sizes provide a continuous supply of susceptible infants. The population size (11,000) and urban nature of Goroka seem also to sustain endemic rotavirus infection.

In contrast, the results from Kundiawa Hospital suggest that the young children in this center and in the surrounding villages were experiencing an epidemic of acute gastroenteritis due to a single rotavirus strain. The population in Kundiawa (approximately 3,000) may be too small to maintain rotavirus as an endemic pathogen. The observed absence of serum antibodies to rotavirus in certain communities in Papua, New Guinea, supports this hypothesis (5).

The "critical community size" for endemicity of infection is different for different viruses. For measles, it is estimated to be 500,000 persons,
and for varicella it is less than 1,000 persons (3). The results of this and two other studies indicate that the critical community size for rotavirus to become an endemic pathogen may be a population of more than 5,000 persons. In the outbreak caused by rotavirus subgroup 1 in northern Brazil, the size of the community was approximately 250 people (7). In the outbreak in the Truk atoll of the Pacific, even though the total population was approximately 23,500, the population of each island was less than 5,000 (4). It is likely that small communities like Kundiawa may experience epidemics at intervals, each new epidemic being caused by a strain introduced from outside. It will be interesting to keep such communities under surveillance to test this hypothesis.

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LITERATURE CITED


ERRATUM

Epidemiology of Rotavirus Diarrhea in the Highlands of Papau New Guinea in 1979 as Revealed by Electrophoresis of Genome RNA

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Page 134, column 1: lines 20-34 should read "Kundiawa and Goroka are separated by a distance of about 80 km, and travel between the two towns is quite common. However, the population of Goroka is nearly four times that of Kundiawa, which has an estimated population of 3,000 and is the largest town in Simbu Province. Goroka has a population of approximately 11,000 and is the largest town in Eastern Highlands Province."

AUTHOR'S CORRECTION

Comparative Study of Selective Media for Isolation of Legionella pneumophila from Potable Water

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Volume 16, no. 4, p. 697, column 2, line 3: It has come to the attention of the author that the use of differential dyes in MWY medium was reported previously by R. M. Vickers et al. (J. Clin. Microbiol. 13:380-382, 1981). He and the editor regret the omission of this citation.