JOURNAL OF CLINICAL MICROBIOLOGY, Dec. 1992, p. 3294–3297
0095-1137/92/123294-04$02.00/0

Vol. 30, No. 12

Nosocomial Transmission of Rotavirus from Patients Admitted with Diarrhea

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Received 13 January 1992/Accepted 18 September 1992

We studied the transmission of rotavirus (RV) in 950 patients under 2 years of age hospitalized for diarrhea in Santiago, Chile. Stool samples were collected every other day from all patients during their entire hospital stay. To trace nosocomial transmission, we mapped the ward at the time of detection of RV. Comparative study by polyacrylamide gel electrophoresis of 315 RV isolates (180 detected upon admission of patients and 135 attributed to nosocomial transmission) allowed the identification of 18 different electropherotypes. An electropherotype similar to that of a community-acquired case was found in the same room in 81% of nosocomial cases and in the ward in 92% of nosocomial cases. It was concluded that the infants admitted shedding RV are the major source of nosocomial transmission and there was not a RV strain that was particularly transmissible.

Rotaviruses (RV) are a major cause of community- and hospital-acquired diarrhea in infants and young children worldwide (1, 2, 9). Pediatric hospitals in developing countries usually have special wards to treat children with diarrhea, in part to handle the large number of patients seen during the summer months but also to control the spread of etiologic agents. However, this practice may lead to increased risk of nosocomial infection among patients hospitalized in the same wards. In previous studies, we have detected nosocomial RV infection rates of up to 20% in children admitted to diarrheal wards (1, 4, 8).

The RV genome has 11 double-stranded RNA segments which can be resolved as separate bands by electrophoresis to yield reproducible profiles. Every isolate has a particular electropherotype, which may exhibit extensive variation of the mobility of one or more segments compared with those of other strains (6, 7, 10, 11, 12, 15). Previous studies in Chile using polyacrylamide gel electrophoresis for RV analyses identified over 30 different patterns (8, 13, 14). In this study, we used electropherotyping of RV as a means of comparing the genomes of clinical isolates to allow us to trace nosocomial RV transmission in a pediatric ward designated for diarrheal diseases in Santiago, Chile.

Stool samples were obtained from 950 infants and young children under 2 years of age hospitalized for acute diarrhea in three rooms (with seven cribs each) of a ward at the Roberto del Río Children's Hospital, Santiago, Chile, between July 1985 and July 1987. The collection of stool samples from all patients hospitalized in these three rooms was conducted every other day during their entire hospital stay. Positive cases were monitored with daily sampling until three consecutive specimens gave negative results. Nosocomial cases were defined as those cases in which RV was shed beyond the third day after admission of the patient. The locations of the patients at the time of RV shedding and the electropherotype detected were recorded in order to trace nosocomial transmission. All positive specimens were stored at −20°C for further comparative studies, which were carried out from 1990 to 1991.

RV diagnosis was performed by a previously described RNA electrophoresis screening technique that uses polyacrylamide minigels and silver staining. For finer comparative analyses, the method described by Spencer et al. was used (8, 13, 14). The different electropherotypes detected were classified as L (long) or S (short), depending on the migration of segments 10 and 11, and subclassified with a number to specify the different strains detected in each L or S pattern (8). Nosocomial RV transmission was traced by comparing the electropherotypes isolated from community- and hospital-acquired cases present in the same room or in the ward at the time when each nosocomial case emerged.

In Chile, RV is detected at a high frequency throughout the year in infants hospitalized for acute diarrhea. In this study, we determined the distribution of electropherotypes throughout the year (classifying them as either new admissions or nosocomial infections) as well as the source of infection of nosocomial cases.

RV was detected in 315 of 950 patients (33%); 180 of these cases were diagnosed upon admission of the patients and 135 were nosocomially acquired. Differences in electrophoretic migration of bands allowed us to define a total of 15 long and 3 short electropherotypes. Electropherotypes exhibit various presentations. Long electropherotypes were present during the whole study period, while short patterns were observed only during 1985 and the first quarter of 1986. Although one electropherotype was predominant in each quarter, the number of electropherotypes simultaneously circulating varied from 4 to 11. Some electropherotypes were seen for short periods (e.g., L4 and L5), while other strains were more endemic (L2 and L14) but exhibited some epidemic peaks. Two of the patterns designated L6 and L7 were present at a high frequency and accounted for more than half of the cases (32.4 and 24.8%, respectively), while others were seen less commonly (L1, L3, L8 to L13, L15, S2, and S3). The temporal distribution of electropherotypes detected more frequently was as follows. L7 predominated in 1985 (35.7%). In 1986, 35.6% of the strains detected were

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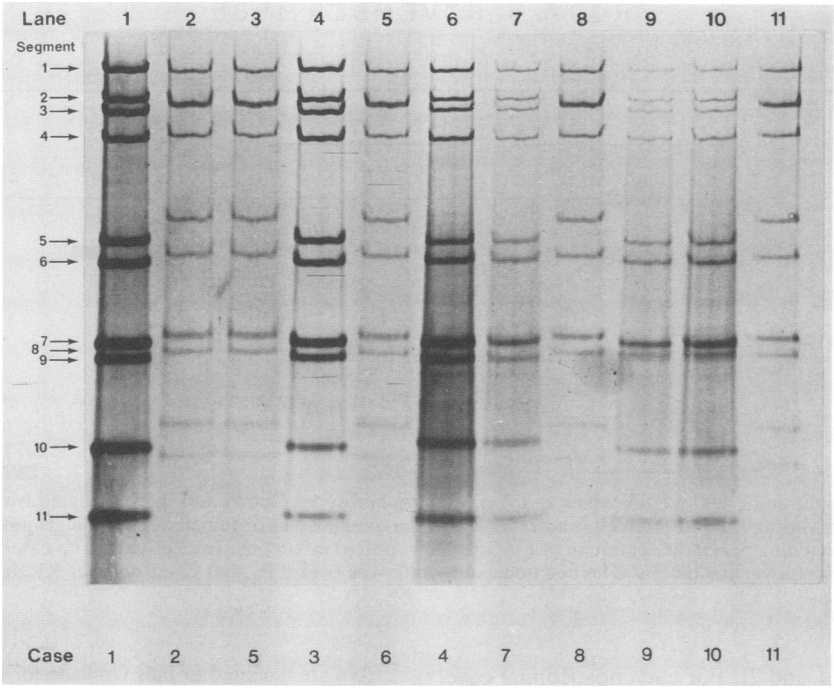

FIG. 1. Electropherotypes of RV isolated from one study room (see Fig. 2). The arrows indicate the 11 RNA gene segments separated by polyacrylamide gel electrophoresis. Long electropherotypes were found for cases 1, 3, 4, 7, 9, and 10, and short electropherotypes were found for cases 2, 5, 6, 8, and 11. The long electropherotype L5 (cases 9 and 10) shows different migration of segments 7 to 9 and 10 in relation to L7 (cases 4 and 7). L14 (case 3) shows different mobility of bands 3, 5, and 10 compared with L7. The migration patterns of all short electropherotypes are similar.

L6, while 17.4% were L7. During 1987, L6 was detected in 61.2% of the cases and L7 was detected in 23.5% of the cases.

Table 1 shows that L6 and L7 were equally detected among community-acquired (32 and 25%, respectively) and hospital-acquired (30 and 27%, respectively) infections. Other less common electropherotypes also had similar nosocomial transmission and community infection frequencies. In general, there was a correlation between the observed frequency of every RV strain in the admission and nosocomial cases. There were no strains that were particularly transmissible, that is, strains detected on admission that led to a high percentage of the nosocomial cases. Short electropherotypes were less common in secondary cases; thus, only 6 cases were detected among the 135 nosocomial infections compared with 16 of 180 admissions.

The variety of electropherotypes constitutes a powerful tool for epidemiological studies, although it does not appear to have clinical significance. The molecular basis for such heterogeneity in electrophoretic patterns and the differential prevalence of the strains detected are not known. The electropherotypes that predominated in patients upon admission were the same as those most frequently observed in nosocomial cases. This suggests that strains which are prevalent at certain times are responsible for both community- and hospital-acquired infections and therefore a hospital reservoir for RV may not exist, as is the case for certain bacteria. These observations on the transmissibility of RV strains complement previous findings on the virulence of RV (8). For example, electropherotypes L6 and L7 could be considered both highly virulent and contagious, because they caused such severe disease that hospitalization was required; however, these same strains produced many secondary cases, the majority of which were asymptomatic.

Electropherotypes present at a particular time were compared in order to find the source of RV infecting the

TABLE 1. RV electropherotypes detected from infants admitted for acute diarrhea and nosocomial cases in Santiago, Chile, in July 1985 through July 1987

Electropherotype	No. of infections (%) acquired from:	
	Admitted patients (n = 180)	Nosocomial transmission (n = 135)
L1	2	1
L2	13 (7.2)	12 (8.9)
L3	0	4
L4	9 (5.0)	8 (5.9)
L5	12 (6.7)	10 (7.4)
L6	57 (31.7)	40 (29.6)
L7	45 (25.0)	36 (26.7)
L8	2	3
L9	1	0
L10	1	0
L11	3	1
L12	1	2
L13	2	0
L14	14 (7.8)	11 (8.1)
L15	2	1
S1	14 (7.8)	4 (2.9)
S2	1	2
S3	1	0

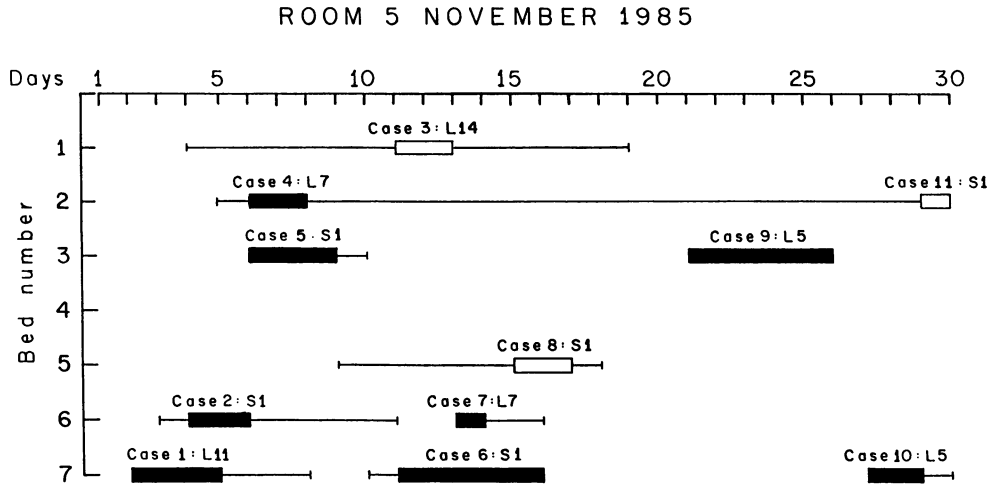

FIG. 2. Temporal distribution of positive RV cases and their electropherotypes (shown in Fig. 1), isolated from patients admitted to one study room with seven beds during 1 month. Each line corresponds to the total hospitalization period of a single positive case. Black and white blocks represent the RV shedding period of community- and hospital-acquired infections, respectively. The case number and corresponding electropherotype are specified over the blocks. The bed occupancy rate was over 85%, but cases without RV detection are not included in the figure.

nosocomial cases (Fig. 1 and 2). For each nosocomial case, simultaneously hospitalized children shedding the same electropherotype were searched for in the same room first and then in the other two rooms of the ward. The analysis of the source of RV transmission showed that 81% of the patients with nosocomially acquired RV had had contact with patients already hospitalized in the same room who were shedding the same electropherotype as that of the secondary case. Furthermore, in 92% of nosocomial cases, the particular electropherotype found was present in the ward at that time. The finding of acquisition of RV infection from newly admitted patients had already been suspected from the clinical observation that the admission of a positive patient was frequently followed by the appearance of successive secondary cases.

In the present study, contact in the room seems to be of prime importance in RV transmission, accounting for 81% of cases; in an additional 11% of cases, the source of virus was found in the other rooms in the ward. The remaining 8% of positive patients in which no source was found could have acquired RV from undetected cases. It has been shown by seroconversion that RV infection may be detected in spite of the fact that stool samples remain negative by the usual diagnostic techniques (5). Therefore, diarrhea cases and subclinical infections present in the ward may have been the source of RV. In addition to the classical fecal-oral route of transmission of RV, the possibility of an airborne route could in part explain its high degree of contagiousness (9). For this reason, when RV was highly prevalent in the community, it is possible that passive carriers from other wards contaminated the section under study for which restrictions on the circulation of personnel had not been implemented.

In summary, the work presented here suggests that infants admitted shedding RV are the major source of nosocomial transmission and that the role of a hospital reservoir, if any, is limited. Finally, there does not appear to be a strain of RV that is particularly transmissible.

This work was supported in part by WHO grant C6.181.197 and DTI, Universidad de Chile, project M 2108.873.3.

We are indebted to Inés Orellana for technical assistance and to Paulina Avendaño and Jorge Flores for valuable editorial comments.

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