

# Rotavirus Shedding by Neonates and Possible Modes of Transmission

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## Summary

Shedding of rotavirus by the neonates and by their mothers was studied throughout the year 1985 in the nurseries of the Maternity and Children's Hospital in Riyadh, Saudi Arabia. One hundred and fifty (35 per cent) of the neonates examined and 15 per cent of their mothers were excreting the virus. Excretion of the virus was throughout the entire year with peak times in early Spring and in the Fall. The high prevalence of rotavirus excretion by the mothers suggested that the mothers were the initial source for the spread of the virus into the neonates and hence into the nurseries. The fact that all the neonates in our study were breast fed may explain the lack of disease in the neonates who were shedding the virus.

Since its discovery in 1973<sup>1</sup> human rotavirus has been recognized as the major etiological agent of infantile gastroenteritis world-wide.<sup>2,3</sup> Although rotavirus-induced gastroenteritis occurs most frequently in children between 6 months and 2 years of age<sup>2,3</sup> several studies from different parts of the world reported that rotavirus can be detected in the stools of neonates<sup>4-12</sup> and this may occur as early as the first day after birth.<sup>7,12</sup> The majority of these studies however point to the common asymptomatic character of the infection. This observation could be due to many factors.<sup>12</sup> These include:

- (i) special characteristics related to the maturation of the gastrointestinal tract in the newborn;
- (ii) the possible attenuated nature of the isolates harboured in the neonates; and
- (iii) the possible protection that may be afforded by breast feeding or transplacentally acquired antibody.

The aim of this study was to investigate the possible mode of transmission of rotavirus to the neonates and study the association between the presence of rotavirus in the stool, and disease in the neonates. This is of particular interest since all the neonates in our study were breast fed.

## Materials and Methods

### *Patient study*

The Maternity and Children's Hospital in Riyadh is the main referral hospital in the Central Province of

Saudi Arabia for neonates and older children. The hospital serves as the main centre for maternity care with deliveries of approximately 20000 per year. A total of 435 neonates and their mothers were included in this study which covered a 1-year period (January 1985–December 1985). The neonates ranged in age from 1 to 10 days after birth and two to four stool samples were collected from each child. Only one stool sample was collected from each mother and this was on the first day after giving birth. The clinical condition on the children was documented at the time the samples were taken and also from discharge records.

### *Virological study*

Each stool specimen was examined for the presence of rotavirus by the commercially available enzyme-linked immunosorbant assay (ELISA) diagnostic kit (Rotazyme) from Abbott Laboratories (North Chicago, Illinois) and by electron microscopy (EM). The ELISA assay was performed as instructed by the manufacturer and the final reading was done on Abbott's programmed spectrophotometer system 'Quantum II'. For EM, a small proportion of the stool was mixed with 0.5 ml of phosphate buffered saline (PBS) and centrifuged for 15 minutes at 3000 rev/min. The supernatant was applied to Formvar-carbon-coated grid, stained negatively with 2 per cent phosphotungstic acid pH 6.5 and screened for virus particles by EM (Jeol 100 CX II).

## Results

One hundred and fifty of the 435 (35 per cent) neonates and 66 (15 per cent) of their mothers shed rota-

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TABLE 1  
Monthly distribution of rotavirus detected in neonates and in their mothers over a 1-year period (Jan 1985–Dec 1985)

	No. neonates	Rota-positive (%)	Mothers rota-positive (%)
January	30	11 (36.7)	6 (20.0)
February	35	15 (42.9)	5 (14.3)
March	30	16 (53.3)	6 (20.0)
April	30	12 (40.0)	6 (20.0)
May	50	17 (34.0)	7 (14.0)
June	40	10 (25.0)	3 (7.5)
July	40	8 (20.0)	5 (12.5)
August	45	12 (26.7)	6 (13.3)
September	40	18 (45.0)	8 (20.0)
October	30	12 (40.0)	6 (17.0)
November	35	11 (31.4)	5 (16.7)
December	30	8 (26.6)	8 (10.0)
	432	150 (34.5)	66 (15.2)

virus as was detected by ELISA and EM (Table 1). The rate of virus detection was higher by ELISA and EM (Table 2); however, positive results by both ELISA and EM were considered in the present study due to the unreliability of Rotazyme ELISA test in neonates.<sup>13</sup> As is evident from Table 1, shedding of the virus was throughout the entire year in both groups with peak times in early Spring and in the Fall. The days on which rotavirus were detected in the stools of the neonates are shown in Table 3. Although the majority of the neonates shed the virus on the 6th day after birth, a substantial number (32 neonates) started to shed the virus on the day of discharge or shortly before it. This indicates that contracting the virus in these neonates was probably due to their longer stay in the hospital.

### Discussion

The most significant findings of this study were the shedding of rotavirus by the neonates and by their mothers all the year round. To our knowledge this is

TABLE 2  
Rotavirus detection (according to method of virus detection) in stool specimens from neonates and mothers

	Detection of rotavirus		
	ELISA	EM	ELISA and EM
Neonates	158	152	150
Mothers	71	65	66

TABLE 3  
Age at which rotavirus was initially detected in neonates

Day after birth	Detection of rotavirus Rota-positive	
	No.	Cumulative (%)
1	4	3
4	50	36
6	64	79
Discharge	32	100
	150	

the first time that detection of rotavirus in mothers of neonates was attempted and the high prevalence (15 per cent) found was surprising. This finding points strongly to the mothers as the primary source for transmission of the virus to the neonates and, hence, its spread in the nurseries. The fact that not all the mothers of rotavirus-positive neonates were excreting the virus indicates that spread of rotavirus in the nurseries also took place via nursing and medical staff, most probably by direct contact. Middleton *et al.*<sup>14</sup> have shown that rotaviral infection is also the cause of often severe hospital-acquired diarrhoea in older infants and that hospital staff were probably responsible for transmitting the infection. Since rotavirus are quite stable for long periods at ambient temperature<sup>15</sup> it is also possible that airborne transmission via aerosols, especially when changing diapers, may have also occurred.

Although rotavirus have been detected all year round in the mothers as well as in the neonates, the prevalence of shedding in both groups showed some seasonal variation with peak times in early Spring and early Fall. This pattern is similar to the pattern of rotavirus infection seen in Saudi children 6 months–2 years of age and to be reported elsewhere.

The majority of studies reported pointed to the asymptomatic character of rotavirus infection in the neonates.<sup>5, 6, 9–11</sup> Severe gastroenteritis, however, was also reported.<sup>4, 7, 8, 12, 16</sup> In our study none of the 150 neonates who were shedding the virus had diarrhoea and none required fluid-replacement therapy. The complete absence of diarrhoeal episodes could possibly have been due to the fact that all of the neonates in our study were breast fed. It has been shown that bottle-fed babies are more prone to rotaviral infection than breast-fed babies since breast milk plays a protective role.<sup>17–19</sup> It is also possible that passively acquired transplacental antibody in addition to breast milk have protected the newborns. Another possible explanation for the absence of symptoms in the neonates is that the circulating virus was non-virulent. Recently, Champsaur *et al.*<sup>20, 21</sup> showed that 27 per cent of the French neonates

studied were rotavirus carriers (harbour the virus, but without generating a systemic immune response) compared to early 2 per cent who experienced infection. The finding that carrier rates decreased progressively with age while true infection (with serological response) increased suggests that some factor of intestinal maturity is involved. The absence of serological data in our study does not allow the distinction between carriers and those who had asymptomatic infection.

Gastroenteritis is a serious problem and mortality rate in developing countries may be 100-times higher than that in the industrialized world.<sup>22</sup> The need for the development of a vaccine against rotavirus therefore is urgent.<sup>23</sup> Recently, Bishop *et al.*<sup>24</sup> reported that children who are infected during the neonatal period suffered less frequent and less episodes of diarrhoea than those who were not. This observation has important application, particularly in the development of strategies for the administration of rotavirus vaccine once this vaccine becomes available.

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