

# Rotavirus and Central Nervous System Symptoms: Cause or Contaminant?

## Case Reports and Review

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Rotavirus is a common cause of severe gastroenteritis in children. In 2 patients with rotavirus gastroenteritis who developed encephalopathy, rotavirus RNA was detected in the cerebrospinal fluid (CSF) by reverse transcription–polymerase chain reaction; in 1 patient, rotavirus RNA was detected on 2 occasions 3 weeks apart. There are increasing reports of cases in which patients who have seizures after an episode of rotavirus diarrhea have evidence of rotavirus in their CSF. A search of 2 large hospital discharge databases suggested that seizures are noted as part of the discharge diagnosis in the records of, at most, <4% of patients with rotavirus diarrhea versus 7% of patients with bacterial diarrhea. Although evidence suggesting that rotavirus is a cause of central nervous system sequelae remains inconclusive, the 2 case reports presented in this study further illustrate a possible association. Further study is required to determine whether detection of rotavirus in CSF represents a true pathogen, CSF contamination that occurs at the time of lumbar puncture or in the laboratory, or carriage of rotavirus RNA in trafficking lymphocytes.

Rotavirus is the primary cause of severe gastroenteritis in children. Infection is localized in the intestine, and only rare reports suggest any morbidity resulting from extraintestinal involvement. Recently, however, a number of investigators have reported CNS complications in association with rotavirus infections [1–12]. Patients with rotavirus diarrhea and benign or severe convulsions, or encephalitis have been found to have evidence of rotavirus in the CSF [4–12]. However, the significance of this finding is unclear. The presence of rotavirus in CSF could be explained as either a cause of

convulsions, contamination of CSF by fecal material introduced during lumbar puncture [13] or in the testing laboratory, or carriage of rotavirus RNA in trafficking lymphocytes. We report 2 cases of children with rotavirus diarrhea who developed encephalopathy and had rotavirus RNA detected in their CSF. In 1 child, rotavirus RNA was detected on 2 occasions, at an interval of 3 weeks. Data and clinical specimens from both patients were referred to the California Encephalitis Project, an enhanced surveillance system designed to better understand encephalitis by systematic data collection and extensive diagnostic testing [14]. In this study, we review the literature on CNS involvement in rotavirus infections and investigate epidemiological links between rotavirus and CNS symptoms from 2 hospitalization databases in the United States.

## METHODS AND RESULTS

This study is based on data from 3 sources: case reports identified in the California Encephalitis Project, analysis

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of hospital discharge records that link the prevalence of CNS diagnoses for children with rotavirus diarrhea and bacterial diarrhea, and a review of the literature on neurological abnormalities that are temporally associated with rotavirus gastroenteritis. In both case reports, physicians referred patients with encephalopathy and other case-definition criteria to the project [14].

**Case report 1.** A previously healthy 6-year-old white boy presented to the emergency department with a 4-day history of recurrent fever (temperature, 40°C) and intermittent episodes of agitation, confusion, and nonsensical speech. He had mild upper respiratory tract symptoms, episodic abdominal pain, and loose, nonbloody stools. En route to the hospital, his entire body became stiff for ~30 s and then turned limp. In the emergency department, the child was awake but disoriented and could not recognize his family. He had a temperature of 36.9°C, a heart rate of 120 beats/min, blood pressure of 90/70 mm Hg, and a respiratory rate of 30 breaths/min.

Initial investigation revealed the following laboratory values: hemoglobin level, 12.1 g/dL; leukocyte count,  $6.3 \times 10^9$  cells/L (66% neutrophils, 28.2% lymphocytes, 5% monocytes, 0.3% eosinophils, and 0.5% basophils); and platelet count,  $129 \times 10^9$  cells/L. Electrolyte levels and results of a liver function panel were normal, and a urine toxicology screen and measurement of serum levels of salicylate and acetaminophen yielded negative results. MRI of the brain yielded normal results. Microscopy of the CSF showed 1 leukocyte and an erythrocyte count of  $40 \times 10^6$  cells/L. The concentration of protein in CSF was 0.3 g/L, and that of glucose in CSF was 0.93 g/L (serum glucose concentration, 1.78 g/L).

The child was transferred to the intensive care unit, where he developed jerky movements of his extremities, and he was noted to have a waxing and waning mental status. He was treated with iv acyclovir, for possible herpes simplex virus (HSV) encephalitis, and with anticonvulsants. However, an initial electroencephalogram did not demonstrate any seizure activity.

Further investigations yielded the following laboratory values: erythrocyte sedimentation rate, 4 mm/h; serum ammonia, 50  $\mu$ mol/L; and creatine kinase, 397 U/L (reference level, 21–215 U/L). Blood smear samples were negative for parasites. Levels of strychnine, arsenic, mercury, and lead in the urine plus the results of a serum amino acid panel and a urine organic acid panel were all unremarkable. Bacterial cultures of blood, urine, CSF, and stool samples showed no growth. CSF microscopy done on hospital day 2 (5 days after the onset of illness) showed the following values: leukocyte count,  $25 \times 10^6$  cells/L (60% lymphocytes, 19% neutrophils, and 21% monocytes); and erythrocyte count,  $123 \times 10^6$  cells/L. The concentration of protein in the CSF was 0.58 g/L, and that of glucose in the CSF was 0.85 g/L (serum glucose concentration, 1.18 g/L).

Over the next several days, the patient continued to have seizure activity. Despite having received aggressive anticonvulsant therapy with phenytoin, phenobarbital, valproic acid, and lorazepam, he required intubation and mechanical ventilation for 2 weeks. Serial encephalograms showed electrographic seizure activity arising from both temporal lobes with secondary generalization. MRI of the brain continued to yield normal results. Acyclovir therapy was continued for 2 weeks, despite negative viral culture and PCR results for the detection of HSV in CSF samples obtained 5 days after the onset of illness, and despite negative results for the detection of acute- and convalescent-phase antibodies to HSV in serum samples obtained at 5 and 18 days after the onset of illness, respectively.

After 2 months of hospitalization for seizure control and prolonged rehabilitation, the patient was discharged while receiving an anticonvulsant regimen of phenobarbital, phenytoin, carbamazepine, and clonazepam. He continued to have occasional seizures as well as persistent deficits in his cognitive, language, and motor function, and he thus required outpatient occupational, physical, and speech therapy. The child subsequently presented, in status epilepticus, to another institution 3 months later. Seizures again were difficult to control, and the patient eventually died. Permission for autopsy was not granted.

A CSF specimen obtained 5 days after the onset of illness was sent to the California Encephalitis Project, where the results of PCR detection of enteroviruses and human herpesviruses (HHV) 1–6 (including HSV-1, HSV-2, varicella-zoster virus [VZV], cytomegalovirus, Epstein-Barr virus [EBV], and HHV-6) were negative. Serum samples obtained at 5 and 18 days after the onset of illness showed no titers of antibody to St. Louis encephalitis virus, Western equine encephalitis virus, HSV, enterovirus, EBV, influenza B virus, rabies virus, *Mycoplasma pneumoniae*, *Bartonella henselae*, and *Bartonella quintana*. Antibodies to VZV, influenza A virus, adenovirus, and *Chlamydia* species were detected, but levels did not rise in convalescent-phase serum samples.

A rectal swab specimen was found to be weakly positive for rotavirus antigen by means of EIA done 1 day after admission and 5 days after the onset of CNS and gastrointestinal symptoms. This sample was unavailable for confirmatory testing by electron microscopy or reverse-transcription (RT) PCR. Two CSF samples obtained on days 6 and 30 after the onset of CNS symptoms were analyzed by RT-PCR performed at the Centers for Disease Control and Prevention (CDC; Atlanta), as described elsewhere [15, 16]. RNA in both samples that were tested with positive and negative controls was repeatedly positive for rotavirus, which had a [P4] genotype, as was determined by sequence analysis and comparison with the DS-1 reference strain. A third CSF sample, obtained 5 months after the onset of CNS symptoms (during the patient's second admission to the hospital), was negative for rotavirus RNA by

RT-PCR. ELISA, performed for the detection of IgA antibodies to rotavirus, yielded negative results ( $<2$  U/mL) in all 3 CSF samples. However, serum samples showed evidence of exposure to rotavirus, as indicated by the presence of detectable levels of rotavirus IgA in samples taken at 5, 12, and 18 days and at 5 months after the onset of CNS symptoms. Results demonstrated no characteristic pattern over time [17], with 16, 14, 17, and 16 U/mL detected, respectively (limit of detection, 2 U/mL).

**Case report 2.** A 2.5-year-old white girl presented to the emergency department with a 5-day history of fever, abdominal discomfort, and green foul-smelling diarrhea. Her birth history was significant for an episode of cyanosis that lasted for  $\sim 2$  min on her first day of life, at which time no clear etiology was determined. On day 3 of life, she was discharged home without any apparent sequelae.

On examination, she had a temperature of  $36.4^{\circ}\text{C}$ , a heart rate of 123 beats/min, blood pressure of 113/62 mm Hg, and a respiratory rate of 36 breaths/min. The child was dehydrated and had diffuse abdominal tenderness.

Initial investigation revealed the following laboratory values: hemoglobin level, 13.6 g/dL; leukocyte count,  $5.6 \times 10^9$  cells/L (26% segmented neutrophils, 15% band neutrophils, 35% lymphocytes, 18% atypical lymphocytes, and 6% monocytes); and platelet count,  $218 \times 10^9$  cells/L. Electrolyte, blood urea nitrogen, and serum creatinine levels were normal, with the exception of a bicarbonate level of 18 mg/dL, a finding consistent with metabolic acidosis. Urinalysis yielded normal results.

The child was admitted for iv rehydration. Several hours later, she awoke from a nap agitated and diaphoretic. Examination done at that time showed an irritable, screaming child with diffusely decreased tone, weakness of the arms and legs, and poor control of the head. She was transferred to the intensive care unit for closer observation.

Further studies, including a liver function panel and CT of the brain and abdomen, yielded normal results. Analysis of the CSF revealed the following values: leukocyte count,  $15 \times 10^6$  cells/L (46% lymphocytes, 36% neutrophils, and 18% monocytes); erythrocyte count,  $10 \times 10^6$  cells/L; protein concentration, 0.42 g/L; and glucose level, 0.56 g/L (serum glucose level, 0.69 g/L). Bacterial cultures of blood, urine, CSF, and stool samples showed no growth. Findings of MRI of the spine were unremarkable, and MRI of the brain showed increased signal intensity in the periventricular deep white matter of the occipital and parietal lobes, which was thought to represent either periventricular leukomalacia secondary to perinatal hypoxic insult or acute disseminated encephalomyelitis. Because of the patient's persistent irritability and diffuse weakness, treatment for the latter possibility was initiated with iv immunoglobulin at a total dose of 2 g/kg given over 5 days, as described elsewhere [18].

The patient subsequently demonstrated steady improvement in her neurological condition. Occupational, physical, and speech therapy were provided to help with residual limitations in mobility, communication, and self-care activities, and the child was discharged, with no residual deficit, after 20 days of hospitalization. Findings of MRI of the brain done 4 months later showed no interval change from the previous MRI findings, suggesting that the abnormalities may have been the result of an earlier insult—perhaps the cyanotic episode that occurred on the child's first day of life. Her recent illness was therefore thought to be consistent with encephalitis.

At the California Encephalitis Project, results of PCR performed on CSF samples obtained at the time of admission were negative for enteroviruses and HHV 1–6. Serum samples obtained 7 days after the onset of illness showed absence of antibodies to St. Louis encephalitis virus, Western equine encephalitis virus, HSV, influenza virus A and B, *B. henselae*, and *B. quintana*. IgG antibodies to VZV, HHV-6, EBV, adenovirus, and measles virus were detected, but these were consistent with immunization or past infection. Convalescent-phase serum titers were difficult to interpret because of the patient's receipt of iv immunoglobulin.

A stool sample obtained at the time of admission tested positive for rotavirus antigen by means of EIA. A rectal swab specimen obtained on day 2 was also positive for rotavirus antigen by EIA. Rotavirus RNA ([P4] genotype) was detected by RT-PCR and subsequent nucleotide sequencing (CDC, Atlanta) of CSF samples obtained at the onset of CNS symptoms (5 days after the onset of diarrhea).

**Epidemiological findings.** We used 2 large data sources to estimate the frequency of CNS abnormalities among children aged 1–59 months who were hospitalized with a specific diagnosis of rotavirus diarrhea, compared with those hospitalized for bacterial diarrheas, as coded by the *International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM)* [19]. Our goals were to determine whether the frequency of diagnosis of CNS problems was significantly greater among children with rotavirus diarrhea than among those with bacterial diarrheas and, if such an association existed, to estimate the frequency with which it might occur.

Data on hospitalizations, as coded by the *ICD-9-CM*, were available from the National Hospital Discharge Survey, which consists of a representative sample (0.5%–1.0% of all hospitalizations) of patient discharge records obtained from short-stay, nonfederal, general, and children's hospitals in the United States [20]. Data from New York State included a comprehensive database of *ICD-9-CM*-coded hospitalizations in the state. Databases were searched for the period beginning in 1993, when the *ICD-9-CM* code for rotavirus was introduced, to 1998, the latest year for which complete data were available. For each of the aforementioned databases, we checked for the following

diagnoses associated with hospitalizations for rotavirus (ICD code 008.61) and hospitalizations for bacterial diarrhea (ICD codes 002–005 and 0080–0085), as coded by *ICD-9-CM*: unspecified convulsions (780.3), infantile spasms (345.6), generalized nonconvulsive epilepsy (345.0), generalized convulsive epilepsy (345.1), unspecified viral encephalitis (049.0), acute encephalitis (049.8), and unspecified viral meningitis (047.9 and 323.9).

From the National Hospital Discharge Survey and New York State databases, the percentage of hospitalizations for rotavirus that were associated with CNS diagnoses varied between 2.5% and 3.7% (table 1), rates that were significantly lower than those among hospitalizations for bacterial diarrhea (3.9%–6.9%;  $P < .0001$ ).

**Rotavirus and CNS complications: literature review.** A MEDLINE search of the literature from 1975 through 2000 yielded 12 case reports or case series in which rotavirus was noted along with CNS complications.

In 3 studies, CSF was not specifically examined for the presence of rotavirus [1–3]. Rotavirus was detected in stool samples obtained from these patients with Reye's syndrome [1], convulsions [2], and Guillain-Barré syndrome [3]. One group reported a case series of 8 patients who had afebrile seizures on days 1–3 of diarrhea [2].

In the other 9 studies, together with the 2 patients described in the present report, a total of 19 patients (age, newborn to 6 years) had evidence of rotavirus in CSF, according to EIA and immune electron microscopy [4], electron microscopy [6], RT-PCR [7–12], or the presence of rotavirus antibodies [11] (table 2). In 3 studies [4, 8, 11], all 3 patients had lymphocytic or monocytic pleocytosis in CSF; whereas, in all others, CSF

was normal. In most of these 19 patients, neurological symptoms that occurred either at the time of or soon after admission to the hospital were temporally preceded by diarrhea [4, 5, 8–12]. Fifteen patients had benign seizures or encephalopathy without long-term sequelae [4, 6–9, 11]. For 4 patients, the outcomes were developmental delay [5], neurological deficit [10], and death [12, present report].

## DISCUSSION

These case reports illustrate that rotavirus RNA may be found in the CSF of patients with gastroenteritis and neurological symptoms. However, the significance of this finding and the mechanism by which rotavirus enters the CSF remain unclear. There remains skepticism about the role of rotavirus in CNS disease, despite the increasing number of cases reported in the literature [1–12]. The detection of rotavirus RNA in the CSF of our 2 patients (for 1 of these patients, rotavirus RNA was detected on 2 occasions) prompted us to review the published reports and search for epidemiological links between rotavirus and CNS symptoms. The detection of rotavirus RNA and the lack of any other identifiable pathogen in the CSF raised the possibility that rotavirus was a cause of the CNS symptoms in our patients. However, the possibility of contamination of the CSF with fecal material at the time of lumbar puncture or in the laboratory, or the presence of rotaviral RNA from trafficking lymphocytes, cannot be ruled out. In the first case report, the detection of rotavirus RNA in 2 CSF samples obtained 3 weeks apart makes fecal contamination unlikely. Furthermore, the IgA antibody titers for this patient support the diagnosis of rotavirus infection, although the role of this virus in his clinical course

**Table 1. Hospitalizations and associated CNS diagnoses, as coded by the *International Classification of Diseases, Ninth Revision, Clinical Modification*, for children aged 1 month through 4 years.**

Data source	Study period, year(s)	No. of hospitalizations for rotavirus	No. (%) of rotavirus CNS diagnoses <sup>a</sup>	No. of hospitalizations for bacterial diarrhea	No. (%) of bacterial diarrhea CNS diagnoses <sup>b</sup>
NHDS	1993–1997	1452	36 (2.5)	415	16 (3.9)
New York State	1993	621	23 (3.7)	766	37 (4.8)
	1994	786	23 (2.8)	782	47 (6.0)
	1995	811	21 (2.6)	717	31 (4.3)
	1996	988	33 (3.3)	635	44 (6.9)
	1997	1080	31 (2.9)	563	32 (5.6)
	1998	855	24 (2.8)	531	24 (4.5)
Total		6593	191 (2.9)	4409	231 (5.2) <sup>c</sup>

**NOTE.** NHDS, National Hospital Discharge Survey.

<sup>a</sup> CNS diagnoses associated with rotavirus.

<sup>b</sup> CNS diagnoses associated with bacterial diarrhea.

<sup>c</sup>  $\chi^2$  value, 39.3;  $P < .0001$ .

**Table 2. Neurological complications associated with rotavirus infections in children: review of the literature.**

Reference, year (location)	Patient age, sex	Clinical presentation		Laboratory detection of rotavirus, by sample					Outcome (time)
		Neurological diagnosis	Symptoms at presentation	Stool	CSF	Blood			
[4], 1984 (California)	6 mo, M	Aseptic meningitis	Diarrhea and vomiting for 6 days; irritable; afebrile	EIA, IEM	EIA and IEM, lymphocytic pleocytosis	—	—	Healthy (10 days)	
[5], 1986 (Japan)	9 mo, M	Acute encephalitis	Diarrhea and vomiting for 5 days; convulsions on day 2	Latex antigen, EM, PAGE, fecal rotavirus IgA	Rotavirus IgG, IgA, and IgM; intrathecal production of IgG; increased protein levels	Rotavirus IgG, IgA, and IgM; CFT	—	Unconscious for 10 days; infantile spasms; pronounced developmental delay	
[6], 1992 (Israel)	2 y, M	Encephalopathy	Fever; lethargy; hypotonia with diarrhea on day 3	EIA	EM	—	—	Healthy (5 days)	
	21 mo, M	Encephalopathy	Diarrhea and vomiting; dehydrated for 1 day	EIA	None	—	—	Healthy (4 days)	
[7], 1993 (Japan)	10 mo to 3 y <sup>a</sup>	Convulsions	Diarrhea and vomiting; convulsions	EIA, 5/5 RT-PCR <sup>b</sup>	RT-PCR <sup>c</sup>	RT-PCR of serum <sup>d</sup>	—	Healthy (1 week)	
[8], 1995 (Japan)	2 y, F	Encephalitis	Diarrhea and vomiting for 6 days; fever; seizures for 3 days	Latex antigen	RT-PCR, monocytic pleocytosis	—	—	Healthy (23 days)	
[9], 1996 (Finland)	9 mo, F	Convulsions	Diarrhea and vomiting; febrile; seizures for 1 day	RT-PCR, EIA	RT-PCR	Rotavirus IgG and IgA, RT-PCR	—	Healthy (5 days)	
[10], 1996 (Japan)	21 mo, F	Encephalopathy, HSE	Diarrhea and vomiting for 1 day; seizures; coma	RT-PCR, EIA	RT-PCR	RT-PCR, CFT	—	Discharged (24 days); hemiparesis/mental retardation	
[11], 1998 (Japan)	2 y, M	Encephalitis	Diarrhea and vomiting for 2 days; afebrile; convulsions	Latex antigen	RT-PCR, rotavirus IgG, ML	CFT	—	Healthy; 2 days	
[12], 2000 (South Africa)	Newborn, M	Convulsions, DIC	Diarrhea and vomiting; convulsions; generalized bleeding	Latex antigen, RT-PCR	RT-PCR	—	—	Died (18 h after delivery)	
Present report, 2000 (California)	6 y, M	Convulsions	Diarrhea for 4 days; confusion; fever	EIA	RT-PCR	Rotavirus IgA	—	Intractable convulsions; died (after 5 mo)	
	2 y, F	Encephalitis	Diarrhea for 5 days; dehydration	EIA	RT-PCR	—	—	Healthy (20 days)	

**NOTE.** CFT, CF test; DIC, disseminated intravascular coagulation; EM, electron microscopy; HSE, hemorrhagic shock and encephalopathy; IEM, immune electron microscopy; ML, mononuclear lymphocytosis; mo, month; RT, reverse transcription; y, year.

<sup>a</sup> Age range is for 8 patients (5 males, 3 females) in a case series.

<sup>b</sup> Five of 5 samples had positive RT-PCR results.

<sup>c</sup> Of samples obtained from 7 patients.

<sup>d</sup> Of serum samples obtained from 2 patients.

remains unclear. The second case had a benign course and was more in line with most previous reports of CNS-associated rotavirus manifestations [2, 4, 6–9, 11].

The detection of rotavirus by various methods, including EIA, immune electron microscopy [4], electron microscopy [6], and RT-PCR [7–12], indicates direct transfer of virus or viral RNA into the CSF. How could rotavirus get into the CSF? One hypothesis is that transfer occurs via an external route in which contamination of the CSF with fecal material occurs during lumbar puncture [13] or in the testing laboratory. This scenario is unlikely for patient 1 because rotavirus persisted in the CSF for 3 weeks, making contamination at the time of lumbar puncture unlikely. In addition, for both patients, sequence analysis showed that the test strains differed from the laboratory reference strain used as a control. An internal route of rotavirus transmission is more difficult to explain, because rotavirus is generally localized in the intestine. However, a few reports suggest that rotavirus does spread outside the intestine. In one report, 4% of infected patients had exanthema, a possible sign of viremia [21]. Rotavirus antigen has been detected in the liver and kidney of 4 immunodeficient children, indicating clear extraintestinal spread of the virus in this unusual group of patients [22]. Recently, rotavirus-specific proteins were found in macrophages and B cells in gut-associated lymphoid tissue after oral inoculation of mice with a murine strain of rotavirus [23]. That finding might indicate another mechanism by which rotavirus may travel from the intestine to extraintestinal sites. It is also possible that increased permeability of the blood-brain barrier in patients with seizures may permit entry of virus or virus-laden lymphocytes into the CSF [24], and the detection of rotavirus in CSF may be as a result, rather than a cause, of convulsions. The role of rotavirus in the neurological course in our first case patient eludes us. An autopsy might have been useful to determine the cause of death and to perform pathological or molecular biology studies of brain tissue for the detection of rotavirus in this patient.

A review of available hospitalization databases in this study showed that, although <4% of rotavirus hospitalizations were associated with CNS diagnoses (table 1), this was significantly less than the rate seen for bacterial diarrhea (4%–7%) in children <5 years ( $P < .0001$ ). However, without a chart review, we are unable to say whether rotavirus preceded or followed CNS diagnoses, and we were unable to exclude simple febrile seizures. A few other studies have reported similar rates of CNS symptoms in patients with rotavirus diarrhea, but control groups are either absent or different. For example, a German study reported CNS symptoms in 2% of children who excreted rotavirus, a rate equal to the prevalence of febrile seizures among all inpatients during the study [25]. In Taiwan, 8 (6.4%) of 125 patients with rotavirus gastroenteritis had convulsions [26]. However, 68% of all patients had a fever with the diarrhea.

In Japan, 35 (2.6%) of 1200 patients with rotavirus gastroenteritis had convulsions [27]. Finally, in a US study [28], 6 (1.2%) of 486 with rotavirus gastroenteritis had afebrile seizures. In this retrospective chart review, patients with known CNS disorders, coexisting CNS infections, or metabolic disorders were excluded [28].

In conclusion, we have established that, at most, 4% of patients with rotavirus may have CNS symptoms, but any causal relationship remains unclear and purely speculative. These case reports and literature review should encourage future studies on rotavirus and CNS complications, but the investigator should be wary of drawing a causal conclusion. The role of rotavirus in CNS disorders can be definitively established only by prospective studies of patients with rotavirus and CNS symptoms, by means of sensitive molecular genetic techniques, attempts at virus cultivation, and rotavirus antibody tests of CSF, stool, and serum specimens. Stool and CSF samples are required for comparison of rotavirus strains genetically and to aid in primer design for detection of small quantities of rotavirus RNA in CSF. Samples may be sent to local reference laboratories or, on request, to the CDC (for sending samples to the CDC, contact Jon Gentsch, Viral Gastroenteritis Section; phone, 404-639-2860; e-mail, jrg4@cdc.gov). Enhanced surveillance systems, such as the California Encephalitis Project, could provide useful epidemiological and laboratory data on the CNS manifestations of rotavirus.

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