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An Outbreak of Water-Borne Gastroenteritis Caused by Diarrheagenic *Escherichia coli* Possessing *eae* Gene

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From July 19 to July 23, 2005, an outbreak of gastroenteritis occurred among the students and teaching staff at a high school in Fukuoka City, Japan. A total of 409 persons, including 393 students and 16 staff members, went camping at a town in Oita Prefecture, from July 18 to 20. Among them, 174 students and 2 staff members showed symptoms such as watery diarrhea, abdominal pain, vomiting and fever (36.5-39.5°C). The foods in the camp were either cooked by the campers or catered. The self-prepared foods were curry and rice, salad and “miso soup with pork”; the catered foods were bread, “box lunches with rice balls,” and sandwiches. The water source of the campground was spring water, and water saved in a tank was supplied to the faucets in the camping facilities. The management company in the campground disinfected the water once a day with hypochlorite and gave users a verbal warning not to drink the water.

Stool samples collected from 20 patients were examined at Fukuoka City Institute for Hygiene and the Environment, and 5 water samples that were collected from the water source, the diversion tank, the storage tank, the toilet and the bathroom were examined at Oita Prefectural Institute of Health and Environment. Although *Escherichia coli* strains were isolated from the stool and water samples, no other food poisoning bacteria were isolated. The strains of *E. coli* isolated from 20 patients were examined by means of PCR to identify the virulence genes (1). Although they were negative for *VT*, *LT*, *ST*, *invE*, *ipaH*, *bfpA* and *aggR*, the strains isolated from 11 patients were positive for *eae*.

The serotype of *eae*-positive *E. coli* strains isolated from

11 patients was OUT:H-, and O168:H- *eae*-positive *E. coli* was also isolated from 1 of the 11 patients. The biochemical properties of these isolates were common: motility -, TSI agar R/Y, β -galactocidase +, and β -glucuronidase - (Table 1). The *E. coli* strains which possessed only *eae* were also isolated from the water samples, and their serotypes were OUT:HNT, O119:HNT, and O168:H-. The biochemical properties of the O168:H- strains isolated from water samples were the same as those of the patient isolate (Table 1).

The strains of *E. coli* OUT:H- and O168:H- isolated from patients were examined by RAPD-PCR using RAPD primers 2, 3 and 4 (Amersham Biosciences Corp., Buckinghamshire, UK). All of the *E. coli* OUT:H- strains showed the same RAPD patterns but differed from the *E. coli* O168:H- strain (data not shown).

According to the epidemiological research of this outbreak, because the onset of symptoms of the patients varied greatly, it was suspected that this outbreak was not a food-borne infection but a water-borne infection. The *E. coli* OUT:H- and O168:H- isolated from the patients and the OUT:HNT, O119:HNT, and O168:H- from the spring water possessed only *eae*. The biochemical properties of the O168:H- strain isolated from a patient was the same as that from the spring water samples. Therefore, it was concluded that this outbreak was caused by enteropathogenic *E. coli*, and the infection source was spring water of the campground.

The public health center found that residual chlorine was not detected in the water supplied to the campground and therefore concluded that water quality management was not

Table 1. Properties of the isolated *E. coli*

	Serotype	β -galactocidase (ONPG)	β -glucuronidase (X-GLUC)	<i>eae</i> gene	TSI agar	No. of positive samples/ No. of samples examined
Patients	OUT:H-	+	-	+	R/Y	11/20
	O168:H-	+	-	+	R/Y	1/20
Spring water (storage tank)	OUT:H NT*	+	+	+	Y/Y	
	O119:H NT*	+	+	+	Y/Y	
	O168:H-	+	-	+	R/Y	
Spring water (bathroom)	O168:H-	+	-	+	R/Y	

*NT, not tested.

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proper. Although the campers knew that the water supplied was not for drinking, they drank the water carelessly, because there were no caution signs where the water was supplied. It is thought that this outbreak was generated by three elements: improper water quality management, insufficient caution signs and a lapse of judgment on the part of the students and the teaching staff.

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