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Epidemiological Studies of an Outbreak of Paratyphoid Fever in the Shima Area of Mie Prefecture

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On 14 December 1993, Mie Prefectural Institute of Public Health and Environmental Sciences was informed by Osaka Prefecture of four cases of paratyphoid fever. All the patients had used the same pension K in the Shima area of Mie Prefecture. Then reports of paratyphoid cases came sequentially. A total of 27 paratyphoid cases were reported from the end of December 1993 to early January 1994. Twenty-four patients used pension K and two used pension U. All of the patients had eaten raw oysters there. One patient was a fisherman who had never used either pension. He retained part of his harvest in the sea near the harbor of the village for personal

consumption. There were 17 patients in Mie, five in Osaka, two in Shizuoka, and one each in Hyogo, Aichi and Yamaguchi Prefectures (Figs. 1 and 2). *Salmonella* Paratyphi A was isolated in all of the patients. The majority of the isolates was that of phage type 2 (PT2). No secondary infections, such as those occurring in family members, were reported.

From November to December 1993, 407 persons used pension K and 140 persons used pension U. All clients of the two pensions were investigated for possible paratyphoid infection. All of them were healthy except patient #9, who had been diagnosed as having a common cold and who also

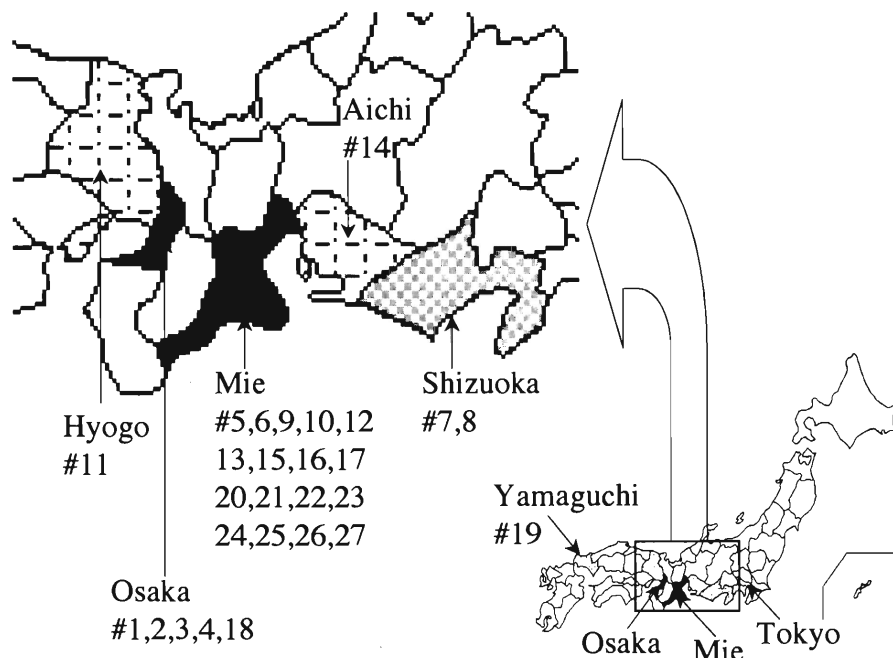


Fig. 1. Geographical distribution of patients.

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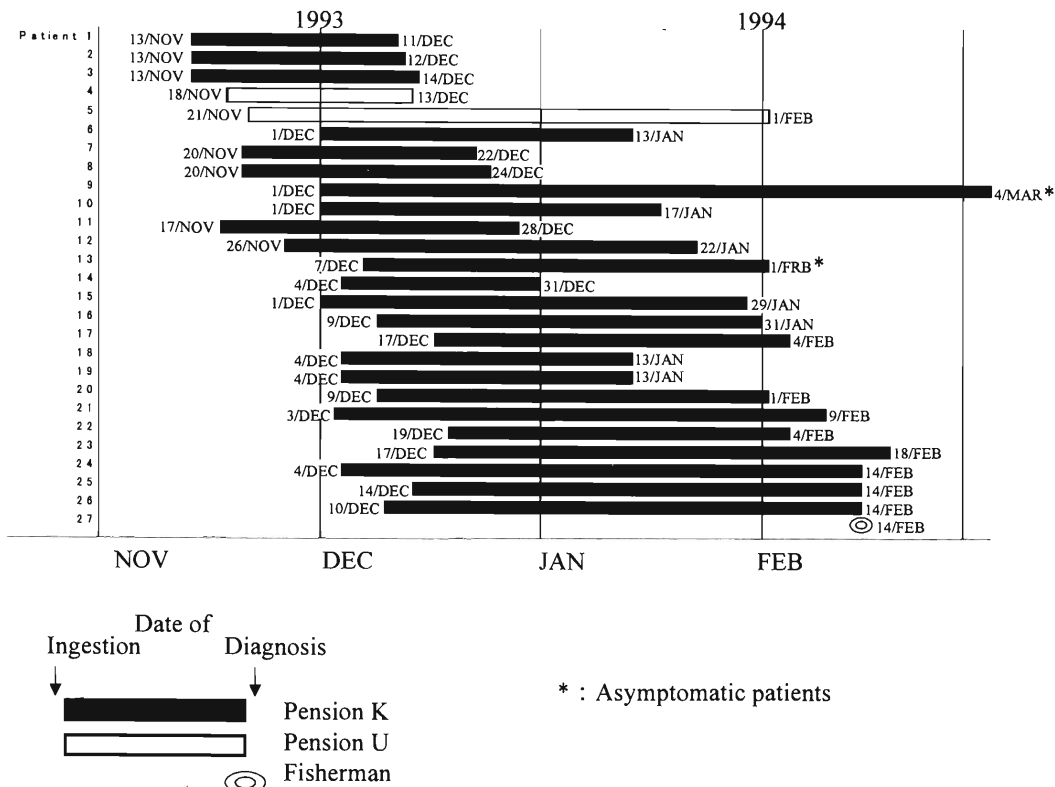


Fig. 2. Chronological distribution of illness in patients-dates of food ingestion and final diagnosis.

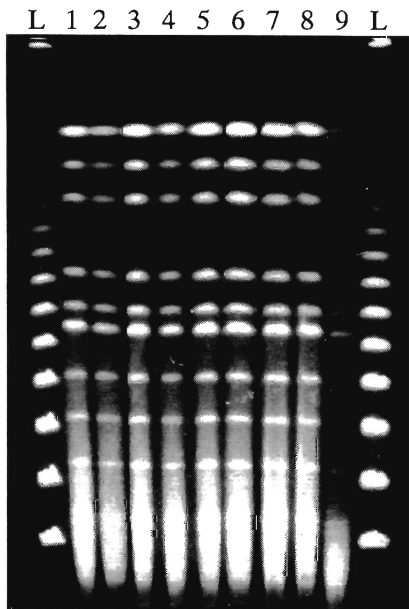


Fig. 3. PFGE analysis of isolates. Bacteria were placed in wells on the top of Inert Agarose Gel, lysed with lysozyme and treated with proteinase K for proteolysis and then with *BlnI* restriction enzyme for DNA digestion. The gel electrophoresis was performed with BioRad CHEF-DR11 under the following conditions: voltage, 6 V/cm; pulse time, 5-50 sec; temperature, 17°C; duration, 23 h. Lane 1: isolate from an underwater mud sample from the harbor. Lanes 2-9: isolates from patients. L: ladder marker.

of all workers in pensions K and U were examined several times. *S. Paratyphi A* was not detected in any of the samples. Foods conserved in refrigerators in both pensions were examined for *S. Paratyphi A* on 15 and 24 December, and none of the refrigerated samples were positive.

All the patients ingested raw oysters. The oysters had been kept in sea water in a harbor about 1 km away from the village where the two pensions were located. The water draining into the harbor or surrounding the oysters kept there was not infected with sewage. Nevertheless, we were able to isolate *S. Paratyphi A* PT2 from one in two mud samples collected on 13 January 1994 near the place where the causative oysters were kept. The PFGE patterns of the sea water isolate and the other patient-derived isolates (Fig. 3) were identical. Further isolation trials from the same or other places were unsuccessful.

This study demonstrated the power of PFGE in epidemiological analysis (1). The data suggest that *S. Paratyphi A* first contaminated the sea water and the mud in the harbor, and then the oysters became contaminated. The phage-type most prevalent in Japan was PT1 (2). PT2, which was associated with the present outbreak, was reported to be more prevalent in Thailand, Indonesia, and other Southeast Asian countries (2). It is quite possible that the *S. Paratyphi*, which caused the present outbreak, was not resident in this area but probably a strain imported from these other countries. It should be noted that the affected area is a famous tourist resort in Japan. In addition, many people from the Southeast Asia come to work in this area.

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had diarrhea at the time of investigation. Stool specimens were collected from 344 persons. Samples from one person (patient #13) were found to be positive for *S. Paratyphi A*; that patient was, however, asymptomatic. Stool specimens

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