

Salmonella Virchow Infection in an Infant Transmitted by Household Dogs

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ABSTRACT. A 4-month-old male infant manifested diarrhea and *Salmonella* Virchow was isolated from his stool. The pathogen was repeatedly isolated from the infant over one month despite three regimens of treatment with antibiotics, to which the isolate was sensitive. Three household dogs were kept in his home and *S. Virchow* was isolated from two of them. The infant was admitted to hospital and was treated with antibiotic, then the pathogen was finally eliminated. Antibiotic sensitivity pattern and PFGE pattern produced by restriction enzyme *Xba* I of the isolate from the infant was completely similar to those of the isolates from the dogs. The above findings indicated that the present *S. Virchow* infection in the infant was transmitted by the household dogs.

KEY WORDS: canine, infant, *Salmonella* Virchow.

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The incidence of *Salmonella* infection including a carrier state in dogs is very important to public health, because dogs are usually kept in close contact with humans [5, 7, 10]. In foreign countries, there have been some reports on transmission of *Salmonella* from dogs to humans [5, 8]. However, there have been no reports on transmission of *Salmonella* from dogs to humans in Japan, although there have been many reports on isolations of *Salmonella* from apparently healthy dogs [1, 4, 9, 14, 15]. The authors have recently reported a case of *S. Infantis* infection in a household dog manifesting severe diarrhea [11], which was the first report on clinical features of *Salmonella* infection in dogs in Japan. The present paper deals with the first report of *S. Virchow* infection in an infant transmitted by household dogs in Japan.

The incidence occurred in a family consisting of a pair of grand parents, a pair of parents and a 4-month-old male infant. There are also three dogs, a Pomeranian, a Papillon and a Japanese spaniel, and the former two dogs were kept inside of the house, mainly in the parents' bedroom and in the corridor (Fig. 1). However, these two dogs often entered into the living room and infant's bedroom, and so had close contact with the infant. The Japanese spaniel was kept in the garden during the daytime and the dog was transferred into a bedroom of the grand parents' house next to the infant's home. These three dogs were fed on a commercial dog food, and boiled chicken meat was also given once or twice a week.

The infant manifested clinical symptoms such as watery diarrhea and slight weakness since 15 January 1998. As diarrhea was observed five to six times per day and his diarrheal stool became laver-like appearance, he was taken to a pediatrics in a hospital on 20 January and bacteriological examination was carried out. The fecal sample was cultured overnight at 37°C on a SS agar plate, a sorbitol MacConkey's agar plate and a blood agar plate, then *Salmonella* Virchow possessing antigens of 6, 7:r:1, 2 was isolated from the specimen. Since *S. Virchow* was isolated from the infant repeatedly as mentioned below, seven isolates were examined respectively for antibiotic sensitivity tests with ampicillin, piperacillin, cefazolin,

cefotiam, cefotaxime, ceftizoxime, cefmetazole, cefaclor, lammoxef, imipenem, amikacin, gentamicin, minocycline, ofloxacin, and fosfomycin by a microdilution method (Dade Behring Ltd., West Sacramento), and all of them were sensitive to those antibiotics.

The infant was given antibiotics since 23 January (Table 1) and the laver-like stool disappeared. However, slight diarrhea or mucous stool still remained despite three regimens of treatment with antibiotics, to which the isolate was sensitive, and *Salmonella* was isolated repeatedly from the fecal sample of the infant when examined on 27 January, 3, 10, 17 and 24 February. Therefore the infant was admitted to the hospital from 27 February and the treatment with antibiotics was suspended for a few days for clinical observation. At the time of admission, routine examinations were carried out on his blood and serum samples and all of their values were in normal ranges. Soon after suspension of the treatment with antibiotics, the infant manifested watery diarrhea seriously and *Salmonella* was still isolated from his stool, therefore he was treated by fosfomycin, to which the isolate was highly sensitive, from 2 March. *Salmonella* isolation finally became negative soon after the treatment and his stool condition improved simultaneously. The infant was discharged from the hospital on 11 March, however he was moved into mother's parental home for two weeks to cut off any contact with the dogs. Fecal samples were taken from the infant on 9, 17, 27 March, 16 April and 22 May and all of them were negative for *Salmonella*. Fecal samples were also taken from the other family members on 18 February and *Salmonella* possessing O 7 antigen was isolated from the grandmother, though she did not manifest any clinical symptoms. She was treated by antibiotics from 28 February for one week. As she was treated in another hospital and *Salmonella* isolate from her was not preserved, no detailed information on her treatment and isolate was available.

Since *S. Virchow* was repeatedly isolated from the infant over one month despite three regimens of treatment with antibiotics, three dogs which were kept in the infant's home and

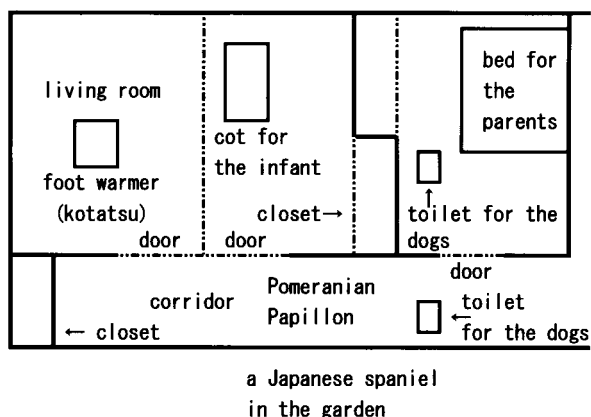


Fig. 1. A schematic figure of the infant's house. Two dogs, the Pomeranian and Papillon, were mainly kept in the parents' bedroom and in the corridor. However, these dogs often enter into the living room and infant's bedroom, thus having close contact with the infant.

showed no clinical symptoms were highly suspected as the source of the infection. Fecal samples were collected from the three dogs on 2 March, and they were cultured overnight at 37°C on a DHL agar plate, to which novobiocin was supplemented to inhibit growth of *Proteus* spp. The samples were cultured also in Hajna tetrathionate broth for enriching *Salmonellae*, then subculture from the broth was made on a DHL agar plate. *S. Virchow* was isolated from the fecal samples of the Pomeranian and Papillon, which were cultured both directly on the DHL agar plate and in the enrichment broth. Six isolates, two from the infant and four from the dogs, were examined for antibiotic sensitivity with 16 disks of ampicillin, cloxacillin, pivmecillinam, fosfomycin, streptomycin, kanamycin, fradiomycin, gentamicin, oxytetracycline, erythromycin, cefazolin, cefuroxime, chloramphenicol, nalidixic acid (Showa, Tokyo), oxolinic acid (Tanabe, Tokyo) and enrofloxacin (Bayer AG, Leverkusen) with a sensitivity test agar (Nissui, Tokyo). They were highly sensitive to ampicillin, oxytetracycline, fosfomycin and oxolinic acid, moderately sensitive to pivmecillinam, streptomycin, kanamycin, fradiomycin, gentamicin, cefazolin, cefuroxime, enrofloxacin, chloramphenicol and nalidixic acid, and resistant to cloxacillin and erythromycin.

For epizootiological surveys, seven wiped samples using sterilized absorbent cotton with saline were collected from the floor of the living room, infant's bedroom, parents' bedroom, corridor and two trays of dogs' toilet (Fig. 1) on 6 March. EEM broth enrichment was done prior to Hajna tetrathionate broth culture for these specimens. Subcultures from Hajna tetrathionate broth were made on DHL agar plates. No *Salmonella* was isolated from any samples collected from the infant's home, however a certain amount of Enterobacteriaceae such as *Escherichia coli* and *Klebsiella* was isolated from the floor of the parents' bedroom, corridor and two trays of dogs' toilet.

Analysis of DNA restriction pattern produced by pulsed-

Table 1. Antibiotic treatment schedule for the infant

| Period | Antibiotics (dosage*) |
|-------------------|------------------------|
| 23 Jan. — 29 Jan. | Cefroxadine (30 mg/kg) |
| 30 Jan. — 12 Feb. | Minocycline (3 mg/kg) |
| 13 Feb. — 26 Feb. | Cefaclor (30 mg/kg) |
| 2 Mar. — 19 Mar. | Fosfomycin (40 mg/kg) |

*: Oral administration.

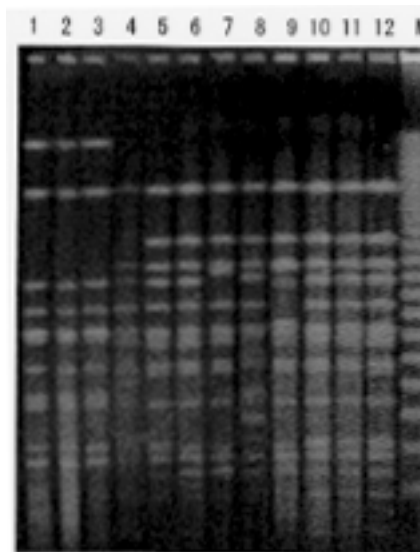


Fig. 2. PFGE patterns of *S. Virchow* with restriction enzyme *Xba* I. PFGE pattern of the isolate derived from the infant (Lane 1) was completely coincident with those of the isolates from the Papillon (Lane 2) and Pomeranian (Lane 3). Lanes 4–12 are patterns of the isolates derived from human food poisoning cases. Lane M indicates a size marker, *Lambda* ladder.

field gel electrophoresis (PFGE) with restriction enzyme *Xba* I was made for three isolates of *S. Virchow*, one from the infant and two from the dogs. Then the PFGE pattern of the isolate from the infant was completely coincident with those of the isolates from the dogs (Fig. 2). PFGE patterns of nine *S. Virchow* isolates derived from human food poisoning cases in Nagano Prefecture were also indicated for comparison.

The above findings clearly indicated that the two household dogs, the Pomeranian and Papillon, had been excreting *Salmonella* and had contaminated the surrounding environment though the pathogen had not been detected from the home environment. Ampicillin, to which the isolate was highly sensitive, was given to all of the three dogs in 200 mg doses per day for one week. Control measures such as cleaning and disinfection of the floor in the home were also done. Furthermore, fecal samples were taken from all of the three dogs on 27 May and 16 December for bacteriological examination, and no *Salmonella* was detected from those materials.

According to reviews of pets and *Salmonella* infection [5,

10], there have been many reports on the transmission of *Salmonella* from companion animals to humans. In Japan, however, there have been a few reports on the transmission of *Salmonella* from those animals to humans, only a report on *S. Typhimurium* infection from a household cat to humans has been available [6]. On the other hand, Fukushima *et al.* [2] reported *Yersinia pseudotuberculosis* infection in children induced by cat-contaminated environmental substances. In the present case, a 4-month-old male infant manifested diarrhea and *S. Virchow* was isolated from his fecal sample. The pathogen was also detected from feces of two dogs kept in his home under close contact with family members. Antibiotic sensitivity and PFGE patterns of the isolate from the infant were completely similar to those of the isolates from the dogs. These findings indicated that the present *S. Virchow* infection in the infant was transmitted by the household dogs.

As it has been reported that the infectivity of *Salmonella* harbored in canine feces was quite high [16], one of the most likely sources of infection to the dogs seemed to be environmental contamination caused by carrier dogs during their exercise walk. Chicken meat contaminated by *Salmonella* [3, 12, 13] was also considered to be a possible source of the infection, though it was given to the dogs after boiling in the present case. In either source, one of the dogs initially was infected by *Salmonella* and two of them had been under carrier state during a certain period, then the infection was transmitted to the infant directly from the dogs or indirectly through environmental contamination. In the present case, *Salmonella* was also isolated from his grandmother, because both she and the infant belong to a highly susceptible age group.

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