

Antibody responses of swine to type A influenza viruses during the past ten years in Japan

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(Accepted 18 January 1988)

SUMMARY

A total of 6346 swine sera collected at an abattoir in the city of Obihiro, Hokkaido during the years 1978–87 were tested for the presence of antibodies to swine and human influenza viruses. A high incidence of antibody to A/New Jersey/8/76 (swine type H1N1) virus was observed throughout the 10 years except for the occasional month and a single long period of 15 months. Antibodies to human H3N2 virus in swine appeared to be related to the epidemics of human influenza which occurred in the study area during the years 1980–3, but unrelated to the epidemics during the years 1984–7. A large number of swine were found to be antibody positive to a human H1N1 virus during the period April to June 1964, and a smaller number, during the period November 1986 to June 1987. Both were in relation to human influenza epidemics. However, there were long periods where human H1N1 antibodies in swine could not be found.

The first occurrence of swine influenza in Japan was recognized in 1977, when it was presumed that the disease was introduced via imported swine (Shibata *et al.* 1978). Further outbreaks of swine influenza and a high prevalence of antibody to the virus in Japanese swine populations have been reported by several workers (Yamane, Sukeno & Ishida, 1978; Sugimura *et al.* 1981; Ogawa *et al.* 1983). An outbreak of influenza virus infection due to an H3N2 strain was previously seen in a herd of swine in Osaka, Japan (Sugimura *et al.* 1975). Later the co-existence of swine (H1N1) and human (H3N2) influenza viruses was confirmed by serological and virological studies on Japanese swine populations (Onta *et al.* 1978; Sugimura *et al.* 1980; Arikawa *et al.* 1982). In a previous report (Miwa *et al.* 1986), we suggested that the swine became infected with a human H1N1 virus as piglets during an epidemic of influenza which occurred in the human population at the same time. The present study was undertaken to evaluate the changes in the prevalence of antibodies against swine and human influenza viruses in Japanese swine during the past 10 years.

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Table 1. Annual incidence of HI antibodies to A/New Jersey/8/76 and A/Yamanashi/2/77 strains in swine sera 1978-87

Year of serum collection	Number HI positive/number tested (percentage)	
	A/NJ/76 (H1N1)	A/YN/77 (H3N2)
1978	9/33 (27.3)	2/33 (6.1)
1979	35/151 (23.3)	5/151 (3.3)
1980	5/756 (0.7)	57/756 (7.5)
1981	90/979 (9.2)	5/979 (0.6)
1982	291/1171 (24.9)	9/117 (0.8)
1983	96/765 (12.5)	132/765 (17.3)
1984	151/631 (23.9)	145/631 (23.0)
1985	86/720 (11.9)	56/720 (7.8)
1986	150/720 (20.8)	74/720 (10.3)
1987	86/420 (20.5)	37/420 (8.8)

Total number tested was 6346.

Sera were collected from 30 to 120 swine (most often in groups of 60) each month during the period December 1978 to July 1987 at the Obihiro abattoir. The swine were approximately 7 months of age. These sera were stored at -30°C until tested.

Serum antibodies to three reference strains of A/New Jersey/8/76 (swine type H1N1), A/Yamanashi/2/77 (human type H3N2), A/USSR/92/77 (human type H1N1) and one Hokkaido strain (A/Hokkaido/1/84, human type H1N1) Miwa *et al.* 1986) were examined by the haemagglutination-inhibition (HI) test using a microtitre method after treatment with both potassium periodate and a commercial receptor-destroying enzyme (Takeda Chemical Industries, Ltd., Osaka, Japan). Details of the methods have been described elsewhere (Goto & Shimizu, 1977; Goto *et al.* 1978), except for the use of ethyl ether-treated virus antigen. An HI titre of ≥ 8 was recorded as positive. All the strains used except the Hokkaido strain were supplied by courtesy of the National Institute of Health and Welfare of Japan, Tokyo, and used after at least 4-6 passages in 10-day-old embryonated hens' eggs in our laboratory. Chicken antisera prepared to the four viruses served as positive controls throughout the experiments.

Human influenza data used in this study were extracted from the national statistics on influenza in school children in the Weekly Report on Infectious Disease by the Bureau of Health Information, Ministry of Health and Welfare of Japan, Tokyo in 1980-7.

The annual incidence of HI antibodies to A/New Jersey/8/76 and A/Yamanashi/2/77 strains in 6346 swine sera are compared in Table 1. No clinical evidence of an outbreak of influenza-like disease in swine was found in the Obihiro district for the years 1978-87, except for January 1982 when a small enzootic of swine H1N1 virus infection was confirmed in a herd by clinical and serological examinations. However, a number of swine sera had detectable HI antibodies to A/New Jersey/8/76 throughout the observation period, although the incidence was very low in the year 1980. HI antibody to A/Yamanashi/2/77 was also found in each year but at a lower frequency except in 1980 and 1983.

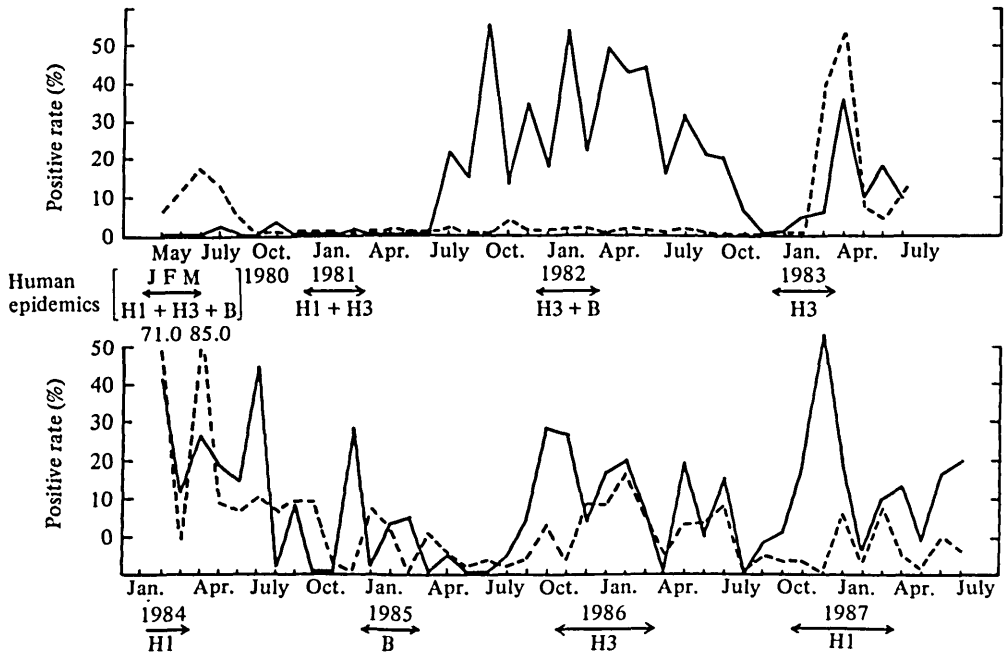


Fig. 1. Monthly distribution of swine sera with HI antibody to A/New Jersey/8/76 (swine type H1N1, —) and A/Yamanashi/2/77 (H3N2, ----) strains in 1980-7. Total number tested was 6162.

When the frequency was analysed by month sera with HI antibodies to A/New Jersey/8/76 were found intermittently; 27.3% (9/33) in December 1978, 44.1% (15/34) in March 1979 and 44.4% (20/45) in May 1979 (data not shown). Very few sera were positive during the 15 months from May 1980 to July 1981 (Fig. 1). However, a number of swine positive for HI antibody to A/New Jersey/8/76 were recognized throughout the latter part of the observation period except for the occasional month. This finding shows that the swine H1N1 virus has been present in swine herds in Obihiro district for several years.

From 1980-3, the only virus consistently present in the human influenza epidemics in Obihiro district was an H3N2 virus (Fig. 1). During the period HI antibody to A/Yamanashi/2/77 was found in large numbers of swine only in June to August 1980 and in March to April 1983. Many swine had HI antibody to A/Yamanashi/2/77 strain throughout the years 1984-7, although H3N2 viruses were not prevalent in the human population in this district during these years except for the period from late 1985 to early 1986. These results suggest that the H3N2 virus circulated among swine for a few years after the H3N2 epidemic in humans which occurred in 1983. The same result has been reported by other workers (Wallace, 1979; Tumova, Stumpa & Mensik, 1980; Mancini *et al.* (1985).

There have been only a few reports on the occurrence of human H1N1 strains of influenza virus among swine populations, in contrast to those of human H3N2 strains (Alexander, 1982; Nerome *et al.* 1982). In the present study antibody to human H1N1 virus was not found during the period 1978-83, although H1N1

strains were prevalent (with other virus strains) in the human epidemics which occurred both in 1980 and 1981. However, a high percentage (30–55%) of swine sera had HI antibodies to A/USSR/92/77 and a smaller percentage (1·7–11·7%) had antibody to A/Hokkaido/1/84 during the periods April to June 1984 and November 1986 to June 1987 (data not shown). Only the H1N1 strains were prevalent among human populations in the winter of each of these years. In Japan, swine are usually slaughtered at the age of 7 months. Therefore the above findings suggest that swine with antibody to human H1N1 virus were inapparently infected with the virus in the first 2–4 months of age during the epidemic of human influenza. Although no human H1N1 antibodies have been observed in swine for a long time, further studies into the persistence of virus in this species are necessary and are now in progress.

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