Swine Vesicular Disease Appeared in Japan

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In 1966 a contagious disease occurred among pigs on two farms in Lombardy, Italy, resembling foot-and-mouth disease (FMD). Although the condition observed was of low morbidity and short duration, the disease was initially diagnosed as FMD on clinical grounds, which were consistent with mild FMD infection. Repeated tests, however, failed to detect the presence of FMD antigen in lesion materials, and subsequent laboratory investigations suggested that the causative agent was a porcine enterovirus. This was the first report of swine vesicular disease (SVD)[8]. In 1971 a similar disease was observed in Hong Kong. The agent responsible for the disease indicated the close serological relationship with the Italian virus[7]. Since 1972 outbreaks of SVD have been reported in several European countries, such as Italy, England, Austria, Poland, France, Federal Repablic of Germany and Switzerland[2]. The disease appeared also in Japan[6),9)] in 1973.

Outbreak and eradication of SVD in Japan

In November 1973, a syndrome was observed among pigs simultaneously on two farms in Ibaraki and Kanagawa prefectures, which was clinically indistinguishable from FMD. Initial serological and biological diagnosis, however, showed no evidence of FMD, but it was confirmed as SVD by further tests in the laboratory. On the following week of the occurrence, affected pigs were detected on several farms neighbouring the epidemic foci, and on one farm in Aichi Prefecture. It was suggestive that the outbreaks were linked to movements of pigs, but the source of the epidemic was obscure. The disease was eradicated within a month by slaughtering 580 heads of infected pigs and restriction of animal movements. After sixteen months of freedom from SVD, an outbreak of the disease was observed on one farm in Tokyo Prefecture. No other occurrence of SVD has been observed in the country.

Laboratory diagnosis

For laboratory diagnosis, vesicular epithelium and fluid were sampled from affected field pigs. Complement fixation (CF) test for detection of virus antigen and inoculation test for virus isolation were carried out with the materials. Positive reaction was not obtained with the materials, by repeated CF tests using guinea-pig antisera to 7 types of FMD and 2 types of vesicular stomatitis viruses. By inoculation with the same materials, typical cytopathic effects were produced on primary swine kidney cell monolayer cultures and cultures of swine kidney cell lines PK-15 and ESK. A virus could be serially passaged on these cultures. No cytopathic change, however, occurred on primary bovine kidney cell monolayer cultures or baby hamster kidney cell line cultures (BHK-21). Suckling mice showed no clinical signs following intraperitoneal or intracerebral inoculation with the materials. The virus isolated on cell cultures showed high stability in pH 5.0 solution, and in 1 M $MgCl_2$ solution at 50°C. These properties of

the virus suggested that the virus might not be FMD but SVD virus[1),3),7),8)]. CF test and virus neutralization (VN) test were subsequently performed with the field samples and harvests from infected cell cultures, using the standard anti-SVD serum which was urgently received from Pirbright Laboratory, England. The results of these tests indicated the presence of SVD virus antigen in the tested samples. SVD virus neutralizing antibody was also detected in 17 of 19 sera derived from clinically infected pigs, and 1 of 9 sera from clinically healthy pigs, on the contaminated farms.

Experimental infection on pigs

Clinical signs were reproduced in pigs by inoculating with either extract of vesicular epithelium or tissue cultured virus[9)]. Infection was achieved by intradermal inoculation into heels and coronary band regions of feet as well as by oral instillation. The inoculated pigs showed vesicular lesions accompanied by lameness, and in some cases fever (40 to 41°C) and inappetite. No diarrhea was observed. Vesicles appeared 2 to 5 days after inoculation. They developed at the bulbs of heels and along the coronary bands, extending into the interdigital space (Plate 1). Vesicles were also observed on the snout and lips (Plate 2). Clinical findings observed on a orally infected pig are shown in Fig. 1.

A high concentration of virus (10^5 to 10^7 $TCID_{50}$/ml) was recovered from vesicular fluid and epithelium of infected pigs. Virus content in the blood, however, was very low, and slight viremia was observed only on the initial stage of infection. It was remarkable that virus was detected in faeces of recovered pigs.

Virus neutralizing antibody was detectable in the infected pig sera on about 5 days after virus inoculation. The antibody titer increased rapidly, and reached a peak 7 to 10 days after inoculation. High level of antibody titer, as 1,000 to 10,000 reciprocal of serum dilution, was observed at the peak, and the titer was maintained for at least 6 months.

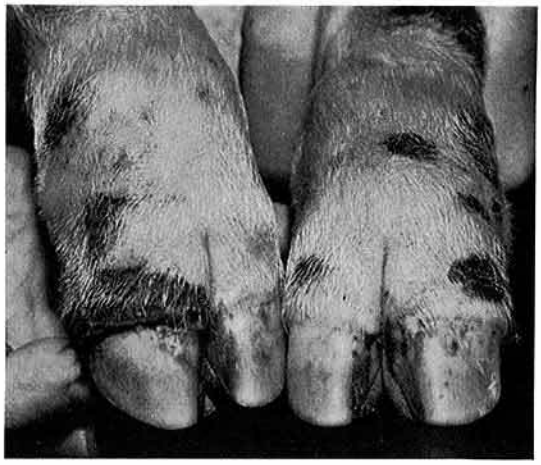

Plate 1. Vesicular lesions on feet

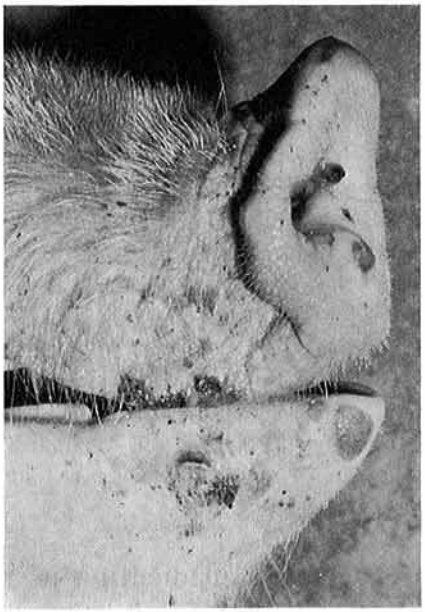

Plate 2. Vesicular lesions on snout and lips

Properties of the isolated virus

Properties of the isolated virus is summarized as follows:

1) pH stability: The virus was highly stable at pH 3.4 to 10.2 in buffered salt solutions.

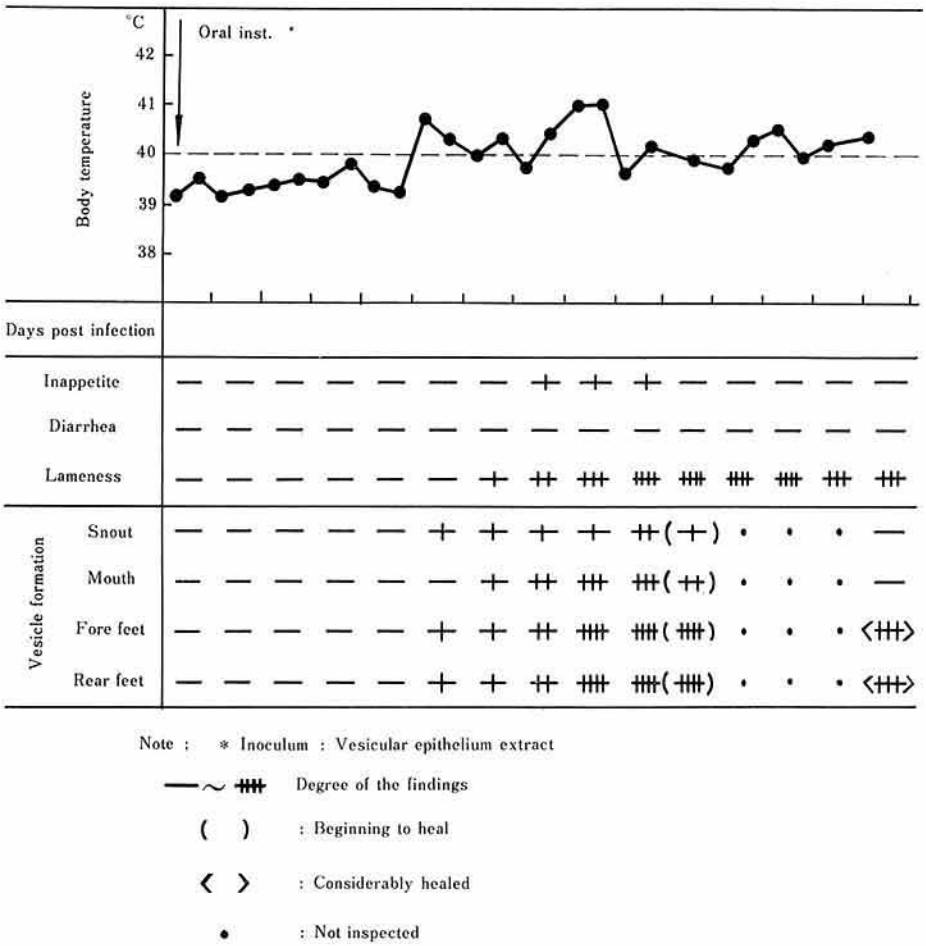

Fig. 1. Clinical observation on the pig infected with SVD virus by oral instillation of vesicular epithelium extract

2) Resistance to chemicals: The virus was resistant to the treatments with 1 M $MgCl_2$ at 50°C, ethyl ether, chloroform, 0.2% sodium desoxycholate, and 1% trypsin.

3) Effect of disinfectant: 5% formalin showed strong disinfective effect on the virus. Considerable disinfective effects were observed with 2% NaOH and 0.1 N HCl solutions. Sodium carbonate, phenol and cresol solutions were scarcely effective. Several commercial products were also examined, but none of them showed disinfective effect on the virus. These properties were in common with those of SVD virus reported[1),3),5),7),8)].

4) Antigenicity: The virus revealed a high cross-reaction with Coxsackie B5 virus on VN test, but did not with any type of porcine enteroviruses.

Survey of SVD antibody on field pigs

To estimate extention of SVD invasion in the country, VN test for SVD antibody was carried out with serum samples derived from healthy field pigs over the whole country[6)]. The samples consisted of 564 stocked sera harvested before SVD outbreak (group-1), and 1,118 sera harvested a month after the

outbreak (group-2). Results of the test are given in Table 1. Some of the samples showed positive reaction in both groups. Antibody titers shown by the positive sera were not higher than 256, except one case in group-2, which was derived from the epidemic area and showed a markedly high titer. No significant difference was observed on pattern and ratio of antibody titer between the two groups. Generally, serum of an infected or recovered pig from SVD shows a remarkably high antibody titer as more than 1,000. It may be reasonable that the exceptional serum in group-2 was derived from a recovered pig without attention. It is still under investigation if low antibody titers observed on the positive sera were due to SVD virus infection, Coxsackie virus infection[5], or any other unknown factors.

Table 1. Result of VN test for SVD antibody, performed with swine serum samples over the whole country

Antibody titer	Number of serum samples (%)	
	Group-1 Before outbreak	Group-2 One month after outbreak
≦2	471 (83.5)	1,023 (91.5)
3～ 4	60 (10.6)	23 (2.1)
4～ 16	25 (4.4)	49 (4.4)
16～ 64	6 (1.1)	20 (1.8)
64～ 256	2 (0.4)	2 (0.2)
256～ 1024		
1024～ 4096		
4096～16384		
16384～65536		
65536<		1*(0.1)

Note: * Serum derived from the epidemic area

Conclusion

Recently, the appearance of swine vesicular disease (SVD) posed a number of problems in differential diagnosis of foot-and-mouth disease in many countries.

A syndrome observed among pigs in Japan was urgently diagnosed as SVD by biological and serological tests, and eradicated by slaughtering infected pigs and animal movement restriction. Extended invasion of the disease was not evident in survey of antibody on field pigs over the whole country[6].

Notice should be made to control SVD that; 1) Large amounts of SVD virus are contained in discharges and faeces of infected pigs[2], and stability of the virus is very strong[1),4]. 2) Airborne transmission of the virus is unlikely[4),10], but the spread of disease depends mainly on the movements of infected pigs and feeding contaminated garbages[2].

References

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