FOOT-AND-MOUTH DISEASE: REACTION OF CONVALESCENT PIGS TO HOMOLOGOUS VIRUS EXPOSURE

*Ivo Gomes**

BRIEF REPORT

Pigs are more difficult to protect against foot-and-mouth disease (FMD) with inactivated virus vaccines than cattle or sheep (4, 6, 7). Also the results of exposure of convalescent pigs to homologous FMD virus have been variable. Cunliffe (2) studied the antibody level of FMD convalescent pigs and re-exposed them to the homologous virus 28 days or 128 days after the initial infection, respectively. Only one of 10 pigs of the last group became clinically ill at re-exposure. However, McKercher and Giordano (8) reported that at re-exposure, from 12 convalescent pigs (90-180 days after infection), 6 showed lesions on the snout or on one or more feet. These authors used contact exposure with FMD-infected pigs as a mean of re-exposure, since this method was considered the one by which pigs would naturally be infected.

Lucam *et al.* (5) pointed to the problem of determining whether one vesicle on an uninoculated foot should be considered as a sign of generalization or as a local lesion caused by virus in the environment entering the body through skin abrasions.

In vaccine potency tests, where generalization is used as the criterion such lesions could lead to false conclusions.

In a recent study of re-exposed convalescent pigs we found that a high percentage of pigs, even those with very high levels of protective antibodies, developed vesicles on one or more of the uninoculated feet. Sixty-four Landrace pigs of 30-35 kg were originally infected by heel inoculation (9) of $10^{4.6}$ mouse LD_{50} in the right hind foot with FMD virus subtype O_1 strain Caseros of bovine origin. Most of the inoculated pigs developed a vesicle at the inoculation site within 24 hours. At Day 3 all pigs had generalized typical foot-and-mouth disease with lesions of the heel and coronary band of all feet, snout and knees. Eight pigs died from FMD during this phase of the experiment or as a consequence of trauma during bleeding. The 56 remaining animals recovered completely only after 45-50 days.

All animals were bled from the precaval vein at monthly intervals, and sera were assayed by the mouse protection test as described by Cunha *et al.* (1) using the same O_1 virus strain, with the results expressed as the mouse protection index (MPI). The pigs were re-exposed to the homologous virus by the same route. Groups of 10 susceptible control pigs were similarly inoculated on each occasion.

Table 1 presents the results obtained in four re-exposure experiments at trimonthly intervals. At 90 days only 2 of the convalescent pigs were completely negative upon re-exposure and did not develop vesicles at the inoculated foot or at any other site. The number of negative animals was highest at 180 days, but only 9 out of 24 pigs were completely negative at re-exposure at 270 and 360 days. Twenty-five negative pigs had high MPIs (> 4.0), with the exception of one in the 180-day group and one in the 270-day group with MPI of 1.3 and 3.5 respectively. None of the 17 pigs which developed only one lesion at the infection site had an MPI less than 4.0.

Table 2 summarizes the data of the 14 convalescent pigs which developed lesions at sites other than the inoculated foot. The lesions generally appeared later in the convalescent than in the control pigs. The most extensive lesions were observed in one pig (No. 10) in the 270-day group which had lesions on 3 feet appearing on Day 3. Two pigs had relatively low MPIs (Nos. 9 and 12) but all others had antibody levels above those which

* Pan American Foot-and-Mouth Disease Center, Caixa Postal 589, ZC-00, Rio de Janeiro, RJ, Brazil.

would have protected cattle well (3).

The large number of pigs which developed lesions at the site of inoculation in spite of high antibody levels suggests that in a heavily contaminated environment vesicles may develop at the site of a skin abrasion. If pigs with such "local" lesions had been subjects of a vaccine potency test and their reactions scored as generalizations, a false impression of the potency of the vaccine would have been obtained. Even though in general recovered pigs showed less severe lesions than susceptible pigs, the use of this criterion for vaccine potency tests is subjective. The results suggest that the serum assay of vaccinated pigs for protective antibodies may be more reliable than the challenge method.

TABLE 1. *Development of foot-and-mouth disease vesicles in convalescent and control pigs after intradermal heel inoculation of one foot*

Days convalescent	No. of pigs inoculated	No. of pigs with vesicles		
		Negative	At inoculation site only	Uninoculated feet
90	16	2	9	5
180	16	14	0	2
270	12	5	4	3
360	12	4	4	4
0*	40	0	0	40

* Susceptible control pigs added to each of the convalescent groups at time of re-exposure.

TABLE 2. *Pigs with lesions at sites other than the inoculated foot*

Pig No.	Days convalescent	Days after inoculation when lesions appeared					MPI
		3	4	5	6	7	
1	90	–*	–	–	+	–	3.8
2		–	–	–	+	–	5.0
3		–	–	–	++	–	> 5.0
4		–	–	–	+	–	> 5.0
5		–	–	–	+	–	> 5.0
6	180	–	–	–	+	–	3.0
7		–	–	–	+	–	5.4
8	270	+	–	–	–	–	3.6
9		–	+	–	–	–	1.4
10		+++	–	–	–	–	2.7
11	360	–	–	++	–	–	> 4.4
12		–	–	+	–	–	1.9
13		–	–	–	–	+	> 4.4
14		–	–	++	–	–	> 4.4
Controls**	0	+++	–	–	–	–	0.0 – 0.1

MPI = Mouse protection index at time of inoculation.

* Lesions on uninoculated feet, + = 1 foot, ++ = 2 feet, +++ = 3 feet, – = clinically normal.

** Susceptible control pigs added to each of the convalescent groups at time of re-exposure.

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