THE MATERNAL TRANSMISSION OF VACCINIAL IMMUNITY IN SWINE

II. The Duration of Active Immunity in the Sow and of Passive Immunity in the Young

By JOHN B. NELSON, Ph.D.

(From the Department of Animal and Plant Pathology of The Rockefeller Institute for Medical Research, Princeton, N. J.)

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Observations on the maternal transmission of immunity to a filterable virus, namely vaccinia virus in swine, were reported in a preceding paper.[1] It was found that pigs which had received colostrum from their vaccinated dams were generally refractory to vaccination during the early days of life, whereas their litter mates which had been raised without colostrum regularly responded to vaccination with a typical cutaneous reaction. It was concluded that the porcine placenta is impermeable to any appreciable amount of the protective substance elicited as the result of vaccination and that the colostrum functions as the vehicle for its transport to the young.

The present report is concerned with 3 additional phases of the transmission of vaccinial immunity in swine, (1) the duration of maternal transfer; (2) the duration of immunity acquired by the suckling young, and (3) the effect of early vaccination on the persistence of this immunity.

The Duration of Maternal Transfer

Two immune sows which had originally been vaccinated in the late fall of 1930 were followed through 6 successive farrowings with the view of determining how long they would continue to transmit protective substances to their nursing young.

Suckling pigs from each of the 6 litters farrowed by the 2 sows were vaccinated during the 1st or 2nd week of life. The test pigs were chosen at random and were

[1] Nelson, J. B., *J. Exp. Med.*, 1932, **56**, 835.

believed to be representative of the several litters. The vaccinia virus[2] was rubbed into parallel scratches made in the skin over the inner surface of the flank. The vaccinated pigs were subsequently kept under observation for a period of 10 to 14 days and during this period they continued to nurse their respective dams.

The results of the vaccination tests on the suckling young from the 2 immune sows, together with the size of the litters and the dates of

TABLE I

The Reaction of the Suckling Young from 6 Successive Litters to Vaccination

Litter No.	Sow No.*	Date of farrowing	No. of pigs	No. of suckling pigs vaccinated	No. of reactors
1	1	Apr. 6, 1931	7	3	0
	2	May 1, 1931	9	3	0
2	1	Oct. 1, 1931	6	3	0
	2	Oct. 18, 1931	8	4	0
3	1	Mar. 20, 1932	6	3	0
	2	Apr. 14, 1932	12	3	0
4	1	Sept. 9, 1932	6	3	0
	2	Oct. 10, 1932	12	4	0
5	1	Mar. 8, 1933	4	2	0
	2	Apr. 28, 1933	10	4	0
6	1	Sept. 5, 1933	7	4	0
	2	Oct. 11, 1933	6	3	0

* The sows were vaccinated in the late fall of 1930.

farrowing are presented in Table I. The pigs from each pair of the 6 litters were uniformly refractory to vaccinia, there being no response to the cutaneously introduced virus in any case. In addition to the young which were tested during the 1st or 2nd week of life a total of 13 pigs, from various litters, were vaccinated at a later time. These pigs likewise failed to show a cutaneous reaction. The suckling young of

[2] The vaccinia virus employed in vaccination was obtained from the Laboratories of the New York City Department of Health through the courtesy of Dr. W. H. Park.

non-vaccinated sows, which were tested at intervals as a control on the potency of the vaccinia virus, invariably developed vesicles at the site of vaccination.

The Duration of the Immunity Acquired by the Suckling Young

With a few exceptions the pigs from the 2 vaccinated sows were allowed to nurse until about the 6th week when they were weaned. In order to determine the approximate duration of the immunity acquired by suckling, representatives from most of the litters were removed at different age intervals and vaccinated.

The results of this experiment are summarized in Table II. Thirteen suckling pigs vaccinated 4 to 5 weeks after birth showed no reaction. Three of 13 weaned pigs vaccinated 8 to 9 weeks after

TABLE II

The Duration of Vaccinial Immunity in the Suckling Young of Immune Sows

	4–5 wks.	8–9 wks.	12–13 wks.
No. tested	13	13	19
No. of reactors	0	10 papular	14 vesicular 5 papular

birth likewise failed to react. Ten of the individuals in this group, however, developed small papules. These were generally discrete, showed little or no color, and usually began to retrogress on the 2nd or 3rd day after they appeared. There was little or no scab formation. This is referred to as a papular reaction in Table II and is regarded as suggestive of a declining immunity. Five of the 19 pigs vaccinated after 12 to 13 weeks also showed a papular reaction. In the remaining 14 pigs of this group vaccination was attended by vesicle formation. The vesicles were usually somewhat smaller than those in fully susceptible control pigs and were more commonly discrete. It is believed, however, that the reaction is sufficiently typical to be indicative of a return to nearly complete susceptibility.

The Effect of Early Vaccination on the Persistence of Suckling Immunity

It was considered of interest to determine whether or not the vaccinia virus which was introduced cutaneously in the nursing pigs

during the first few days of life exerted any immunizing effect in the absence of a visible local reaction. Was the transient immunity acquired by suckling converted thereby into one of long duration? To answer this question suckling pigs which had been vaccinated, without take, shortly after birth were revaccinated 12 to 13 weeks later and their response compared with that in litter mates which had also nursed but had not been previously vaccinated.

The results of the tests on 9 pairs of pigs from 6 different litters are presented in Table III. In eight cases the paired pigs showed practically identical reactions. In one instance only, Pair 5, was a

TABLE III

The Response of Vaccinated and Unvaccinated Litter Mates to Vaccination during the 12th to 13th Week of Life

No.	Type of reaction	
	Vaccinated young	Unvaccinated young
1	Vesicular	Vesicular
2	"	"
3	Papular	Papular
4	Vesicular	Vesicular
5	Papular	"
6	Vesicular	"
7	"	"
8	"	"
9	Papular	Papular

difference in the degree of susceptibility indicated. The previously vaccinated pig in this case showed a papular reaction while its unvaccinated litter mate responded with the formation of vesicles.

DISCUSSION

Since there is no reason to believe that the suckling pigs which were tested were different in any respect from their unvaccinated litter mates, it can be assumed that their immune dams produced and transported in their colostrum, during the 3 year period of observation, a sufficient amount of protective substance to afford immunity in the one case to 37 and the other to 57 young. These figures represent the total number of pigs farrowed by each of the 2 sows, respectively.

It appears evident that the immune mechanism of the vaccinated sow is able to compensate repeatedly for the amount of protective substance which is lost with each parturition. The actual concentration which is lost in this way must be considerable since protection may be afforded to as many as 12 individuals at the termination of a single pregnancy.

The immunity acquired by the nursing pigs was clearly passive. In most instances complete protection was afforded only during the first 4 or 5 weeks after birth, at least in so far as the concentration of virus employed in vaccination was concerned. The immunity began to decline during the 2nd month and by the end of the 3rd month approximately 75 per cent of the pigs were again susceptible. There was no indication that the decline in protection was any more rapid with the pigs of the 6th litters than with those of the earlier ones. The duration of the suckling immunity was not significantly prolonged by the virus which was cutaneously introduced, without reaction, during the early days of life.

SUMMARY

The protective substances produced by vaccinia virus in swine are transmitted repeatedly to the young by way of the colostrum of the sow. In 2 instances suckling immunity was demonstrable in the young of 6 successive farrowings which numbered 37 and 57 individuals, respectively.

The immunity acquired by suckling began to decline during the 2nd month and was practically negligible by the end of the 3rd month. Vaccinia virus introduced cutaneously during the first few days of life in the passively protected pigs exerted little or no immunizing effect.