Fowl Cholera Immunization in Turkeys

II. Use of Experimental Epornitic Method to Study Vaccine Efficacy in Flocks of Turkeys

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Groups of turkeys were challenged with Pasteurella multocida (P-1059) by the contact method. In this method, turkeys are artificially infected by the intramuscular injection of P. multocida organisms and are then introduced into the test group. The death patterns resulting from this contact method of challenge are either normally distributed or skewed to the right.

One of the basic problems in the evaluation of an immunizing agent is to construct a technique of testing efficacy which will have relevance to the disease problem encountered in the field. Traditionally, experimental evaluation of immunizing agents has been by direct challenge of individual experimental subjects.

In the case of experiments dealing with fowl cholera bacterins, two methods of challenge are currently in fashion. These methods are swabbing the palatine nasal cleft and intramuscular injection (1, 3, 4, 5, 6). In all cases, an attempt is made to standardize the challenge culture by determining the number of Pasteurella multocida organisms.

The object of this study is to examine the feasibility of the contact method of challenge. Therefore, the hypothesis was advanced that contact challenge results in a normally distributed pattern of death.

MATERIALS AND METHODS

Seven-week-old Beltsville white turkeys were obtained from a commercial source. These birds were maintained under standard conditions for the balance of the experiment.

The flock of 1,500 turkeys was randomly divided into lots of 15 each. Various lots were immunized with P. multocida cell fractions as described by Brown et al. (2). The vaccinated turkeys were challenged by contact with artificially infected turkeys. This paper deals with an analysis of the death pattern in the negative control birds of these experiments. These turkeys were described as "negative controls" because they were injected only with the vaccine vehicle.

The distribution of deaths after challenge was examined for its relationship to a normal distribution. The analysis was done by using the technique of "goodness of fit" (9).

RESULTS

The vaccine trials making up the framework of this study were divided into two groups (2). Thus, there are two sets of negative controls to be considered.

At the termination of the experiment, the number of birds dying per day was tabulated. From this tabulation, a class interval was calculated and frequency histograms were constructed (Fig. 1 and 2). From the same data, normal curves were determined (Fig. 1 and 2).

In trial I, a comparison between the observed death pattern and that expected was not significantly different ($\chi^2 = 4.62$).

In trial II, the same comparison was significantly different ($\chi^2 = 18.47$).

DISCUSSION

The effectiveness of the contact challenge method is borne out by the death patterns produced in the control turkeys in both trials. In trial I, the observed death rate forms a pattern which can be described as Gaussian. This bell-shaped curve indicates normal distribution. The biological significance of this distribution is that each individual in the negative control group was exposed to the infection in some random manner, and each individual turkey responded to this exposure as dictated by its own particular innate resistance.

The death pattern in trial II does not have a normal distribution in that the observed deaths are skewed to the right. This variance of the

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death pattern from the expected may be due to an environmental stress in the form of a heat wave which occurred about the 5th day of the challenge period. This stress appears to have altered the "structure" of the epornitic, in that the vast majority of the infected population (control and vaccinated birds) died during this period. As a result of these deaths, the number of infected birds was greatly reduced. This, coupled with the increased space in the environment, slowed the spread of infection to the previously uninfected birds. Thus, the data were distinctly skewed to the right.

This is in contrast to the severe skewing to the left of the death patterns seen when intramuscular or palatine nasal cleft swab challenge methods are used. Typically, for intramuscular challenge, the deaths in the controls are confined to the first day after challenge (1, 5). A similar picture is seen for the swab method in which birds died within 2 days after challenge (6, 7).

From the rigorous method of challenge, one would assume that if a vaccinated bird survived it would have immunity against infection. It would follow, then, that birds vaccinated in a similar manner would survive field outbreaks. In fact, this is not true. The question is raised concerning the relevancy of these challenge techniques to test the efficacy of fowl cholera vaccines/bacterins.

Experimental epornitics produced by the contact challenge method resemble field outbreaks in that heavy losses occur within a few days after exposure and are then followed by intermittent losses over a longer period (8). This mimicry of nature lends weight to the desirability of evaluating vaccines by the contact method of challenge.

For this reason, it is suggested that contact challenge is the preferred method of evaluating vaccines. This statement must be qualified to include "that the time of challenge be considered" (2).

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