Can Johne's Disease (Paratuberculosis) be Eradicated?

Aubrey B. Larsen, *D.V.M.*
National Animal Disease Center
Agricultural Research Service
U.S. Department of Agriculture, P.O. Box 70
Ames, Iowa 50010

I will begin by briefly reviewing the symptoms of Johne's disease. Then I will discuss some of the reasons that this disease has not been controlled and eradicated and the extent of our knowledge about this disease.

Cattle in infected herds fall into four categories: (5) (1) clinically ill cattle; (2) asymptomatic shedders; (3) asymptomatic infected cattle that do not shed enough bacilli to be culturally detectable; and (4) uninfected cattle.

Category 1 consists of cattle with disease signs that shed bacilli in their feces. These clinically ill cattle are usually two years of age or older. Clinical disease may be confused with malnutrition, traumatic gastritis, abscesses of the liver, parasitism, coccidiosis, and possibly other conditions. The disease occurs sporadically, so there are seldom more than one or two sick cattle at any point in time unless the herd is unusually large. Unthriftiness and a drop in milk production are the first signs. Later the cow develops diarrhea that may be continous or intermittent, and the feces may vary from watery to almost normal consistency and have a fetid odor. The appetite is variable; some days the diseased animal eats fairly well, and the other days it is listless and inappetent. Body temperature increases intermittently. The cow loses weight gradually until it becomes extremely thin.

Cattle in *category 2* shed bacilli in their feces but show no outward signs of disease.

Category 3 consists of cattle from which *Mycobacterium paratuberculosis* can be cultured from tissues on postmortem, but otherwise appear healthy and are not shedding enough bacilli in the feces to be detected culturally. Many of these cattle will eventually show clinical signs of disease. At present, there is no method to detect cattle in this category.

Cattle in *category 4* are normal, but some may react to skin tests and serologic tests; tissues obtained from these cattle postmortem examination are culturally negative. Some workers believe that some of the cattle in this category may have recovered from a light infection.

Some of the reasons that this disease has not been controlled or eradicated are: (1) apathy of the livestock producer; (2) the name "paratuberculosis"; (3) the concern of regulatory authorities with cross sensitivity within the genus *"Mycobacterium"*; and (4) the need for a good diagnositic agent.

The illness and death of an individual animal are not taken seriously by many livestock producers. If eight or ten animals are found dead or dying in a single day from an acute infectious disease, the producer seeks action. However, he is not nearly as concerned about losses of equal magnitude spread out over a two-year period. The fact that losses from a chronic disease over a period of time may be greater than losses from an acute disease striking only once is not the subject of deep thought.

The name "paratuberculosis" implied to some authorities that research findings on tuberculosis could be applied to paratuberculosis without further trials. For a number of years a test and slaughter procedure using johnin was recommended. Only after a six-year study with an infected herd did we show that a test and slaughter procedure was not satisfactory for controlling the disease (12). I am going to discuss what we found in that study.

The johnin test was used in this herd of approximately 175 cattle. All adults were tested twice each year for five years. During this period, 96 cattle were slaughtered, and selected tissues from each were examined in the laboratory for the presence of *M. paratuberculosis.* Cattle were sent to slaughter at the discretion of the owner, and replacements were made with calves born on the premises. During the five-year period, 46 of the slaughtered cattle were reactors and 50 were nonreactors. Of the 46 reactors, 15 subsequently developed clinical signs of Johne's disease. *M. paratuberculosis* was found in these 15 and six other reactors. Ten of the 50 nonreactors subsequently developed clinical signs of Johne's disease. The bacillus wes found in tissues of these 10 cattle and 10 other nonreactors.

We concluded that not all infected cattle can be detected by intradermal johnin tests. We also found that reactors to the intradermal test frequently became nonreactors and that sensitivity is often temporary or intermittent. From these results, we concluded that diseased cattle cannot be eliminated from most herds by a testing

program with the intradermal johnin test.

This herd was also used for determining the value of the complement-fixation test and the hemagglutination test (11,13). Blood was drawn from each animal at the time of the intradermal johnin test. Serum obtained from these blood samples was used for making these tests. Neither test was of any greater value than the intradermal test as a diagnostic aid.

The test that we *do* recommend for diagnosing the disease in cattle showing clinical signs is the intravenous johnin test (6). This test, when properly used, will be positive in about 80% of the cattle showing clinical signs of disease. (A negative test does not necessarily mean that an animal is not infected.)

The concern of regulatory authorities with cross-sensitivity within the genus *Mycobacterium* resulted in a discouraging attitude toward experimental vaccination studies. These authorities thought that sensitivity to tuberculin from vaccines against Johne's disease would cause problems in the tuberculosis eradication program. However, attitudes have been changing, and a study was made to determine the level of tuberculin sensitivity that would develop in cattle vaccinated with disrupted *M. paratuberculosis* cells in Freund's adjuvant (9). Results of intradermal testing with mammalian tuberculin injected in the caudal fold showed that: six months after vaccination, 70% of the vaccinates showed significant reactions. However, sensitivity decreased, and 50% of the vaccinates were negative to a tuberculin test administered 18 months after vaccination. The rest developed reactions ranging in size from P^1 to P^2. The results of comparative tests on these cattle showed significantly larger reactions to avian tuberculin and johnin than to mammalian tuberculin. After these tests were completed, eight of the vaccinated cattle were exposed to *Mycobacterium bovis*. Results of additional tests indicated that tuberculosis infection markedly increased sensitivity of the cattle to mammalian tuberculin and slightly increased their sensitivity to johnin. Vaccinated cattle that were exposed to bovine tuberculosis organisms thus could be identified by comparative tests with johnin and tuberculin. However, when infected herds for vaccination trials are selected only herds with no history of tuberculosis should be included.

Before starting a control and eradication program, we must consider the extent of our knowledge in seven areas: (1) the economic cost of the disease; (2) reservoirs of infection in animals other than domestic ruminants; (3) the frequency of prenatal infection; (4) the effect of sanitation, husbandry practices, and nutrition on disease losses; (5) the value of fecal culture as a method of culling for control; (6) the value of vaccination as a method of control; and (7) the value of a combination of items four, five, and six as a method of control.

I will discuss these areas one at a time. The economic cost of the disease is not known, and more

effort is needed to get a better estimate. However, we do know that the disease is widespread, and we do have records of losses experienced in infected herds. The losses vary from one herd to another and appear to be dependent on husbandry practices (8).

Hogs can act as a reservoir of infection, but this reservoir would not likely pose any problem in a control program (10). Whether wild ruminants act as a reservoir of infection is unknown. Effort should be made to obtain this information.

The bacillus has been isolated from the reproductive tract of both males and females and from the fetus (7,4,1). The importance of these findings with respect to control of the disease is unknown.

Good management, good sanitary practices, good nutrition, and raising calves separately from the adults will greatly reduce losses from the disease but will not eliminate it (8). On the other hand, herds in which poor husbandry practices and poor sanitation are the rule will experience annual losses from the disease that will be measured in thousands of dollars. In addition, infected cattle apparently are more susceptible to mammary infection and infertility problems (16).

At present, work is in progress in which fecal culture is being evaluated as a method for controlling the disease. This procedure has the advantage that those cattle shedding the bacillus in feces are detected (15). Such cattle obviously are a hazard to all susceptible cattle in the herd. This procedure has two disadvantages: (1) Results of the test cannot be obtained for three months. In the meantime, the positive animal continues to shed bacilli; and (2) the procedure does not detect diseased animals that are shedding fewer than 100 bacilli per gram of feces (14). Some diseased animals do not shed bacilli at all, and others are intermittent shedders. This procedure, in combination with sanitation and adequate nutrition, appears to be the method of choice for controlling the disease in lightly infected herds.

Results from studies conducted in Great Britain, France, and Holland indicate that vaccination may be valuable in controlling Johne's disease in herds with a high morbidity (2,17,3). Therefore, immunization products must be prepared by different methods and evaluated in field trials. Presently, we have a vaccination trial under way. This trial involves 570 cattle and was started in 1970; killed vaccines are used. When the trial is completed, the data will be compiled and published.

However, we still need additional information in four areas: (1) Does a vaccine prepared from killed virulent bacilli contain antigenic components that are not present in vaccines prepared from avirulent stock cultures? (2) What is the best method of killing the bacillus? (3) At what age should calves be vaccinated? (4) Can a vaccination procedure be developed that will eliminate an unsightly nodule at the vaccination site?

The best approach for obtaining this information would be the development of field trials in which vaccinates and controls are randomly selected and identified in infected herds. The advantages to field trial evaluation lie in the natural method of exposure and the large number of cattle that can be used.

Quite likely, a combination of sanitation, good husbandry, good nutrition, fecal culture, and vaccination will completely eliminate the disease from infected herds. In the meantime, a number of livestock owners with infected herds should be able to obtain relief by participating in some of these trials.

References

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