

Clinical approach to control of bovine paratuberculosis

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Paratuberculosis (Johne's disease) has emerged as one of the most prevalent and costly infectious diseases of dairy cattle today. It also affects the beef cattle industry, particularly purebred cattle breeders. Previous updates on paratuberculosis in this journal have comprehensively reviewed every facet of the causative agent, *Mycobacterium paratuberculosis*, and the disease.¹ This information has been updated in recent reviews in other journals.²⁻⁶ Although they are excellent compilations of facts and recommendations, few of these articles have dealt with practical issues of how to deal with *M paratuberculosis*-infected herds. In my opinion, several key factors in deciding which type of control program is best suited to each cattle enterprise have been ignored. Consequently, the purpose of this article is to outline a rational approach to assess a paratuberculosis problem and develop a plan to eradicate the disease or bring it under control that is economical and suited to each farm.

Facts about the pathobiology of paratuberculosis are documented in the aforementioned literature. Recommended control measures are consistent with those of other publications and are reinforced by personal experience. The article recommends 3 questions to pose to the herd owner, gives 6 facts about paratuberculosis that owners must understand and on which decisions for the herd should be based, and 3 steps to follow in structuring a control/eradication program. Certain facts are stated as generalizations to simplify the discussion.

Fundamental to the clinical approach to a paratuberculosis problem are the following precepts:

(1) Paratuberculosis must be managed as a herd problem, not merely treated as a disease of an individual animal, and the infection must be controlled to improve a herd's productivity and profitability.

(2) Paratuberculosis is an infectious disease.

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The rate of infection in a herd will only increase with time unless something is done to intervene.

(3) Paratuberculosis can be controlled. New diagnostic technology and recent research on the epidemiology of paratuberculosis make it feasible to intervene in a cost-effective manner to halt, then reverse the spread of the infection.

In my experience, many practitioners are unaware of new information about paratuberculosis and/or refuse to accept the aforementioned precepts. The result is that, aside from making an occasional diagnosis of paratuberculosis and recommending culling the animal, little is done to deal with the problem at the herd level. Granted, it is also true that herd owners are often unwilling to address the problem until they see how economically devastating the infection can become.

Consistent with modern approaches to production animal medicine, many factors outside the pathobiology of the disease and the accuracy of diagnostic techniques must be considered in formulation of a rational paratuberculosis control program. There are 3 questions that should be asked of the herd owner before proceeding:

Question 1—What is the primary business objective of the cattle enterprise: milk production, meat production, or rearing of breeding stock? Commercial milk producers will not be appreciably affected economically by paratuberculosis, provided the infection rate in the herd (prevalence) is < 5%. The disease causes 5 to 25% reduction in milk production and shortens the productive life of a cow in a herd. There are little data on the effect of paratuberculosis on feeder cattle, but it is not likely that the growth of feeder cattle is affected from birth to market age.

Breeders and owners of registered cattle provide seedstock for other herds and, thus, have an obligation to prevent transmission of *M paratuberculosis*. Essentially every herd that becomes infected with *M paratuberculosis* does so by purchase of an infected animal, cow or bull. Consequently, herds of breeding cattle or any herd that sells herd

replacements should become *M paratuberculosis*-free for the benefit of the industry.

Question 2—How long does the owner intend to stay in business? Paratuberculosis is among the slowest progressing infectious diseases of cattle. It takes a considerable number of years for clinical disease to become evident after introduction of the infection into a herd, and it takes a similarly long period, ≥ 5 years, to eradicate the infection, depending on how aggressively eradication is pursued. In today's business climate, for dairy producers in particular, unless the owner intends to keep his/her herd for > 5 years, little profit will be realized from a paratuberculosis control program.

Question 3—How aggressively does the owner want to tackle the paratuberculosis problem? Many factors enter into the decision: type of cattle business, profitability of the particular enterprise, indebtedness and cash flow of the business, knowledge and understanding of paratuberculosis, and perceptions of the client, or perhaps those of his/her neighbors, about the disease. Veterinarians should try to provide the most accurate current knowledge about paratuberculosis. It is up to owners to decide how much they can afford to spend to control the infection. The difficulty comes in evaluating the long-term benefits of investment in paratuberculosis control. The following facts about paratuberculosis should, therefore, be stressed to herd owners:

(1) Paratuberculosis decreases milk production of subclinically infected cows as early as first lactation.

(2) Paratuberculosis shortens the productive herd-life of cattle.

(3) Young cattle are more susceptible than are older animals. The critical window of susceptibility is roughly the first 6 months of life.

(4) *Mycobacterium paratuberculosis* is principally transmitted by the fecal/oral route, but can also be transmitted in utero and from milk of infected cows, more so in cows with late-stage infections. Because of this, calves born to infected cows have higher likelihood of becoming infected than do calves born to noninfected cows.

(5) Because cattle herds are usually closed self-replicating populations, unless something is done to intervene, the *M paratuberculosis* infection rate in the herd will increase with time.

(6) Control of paratuberculosis takes time and requires management changes to minimize the chances of infecting calves, and culling of *M paratuberculosis*-infected adults from the herd. Culling only clinically ill cows with paratuberculosis is not sufficient to control spread of the infection.

If a herd owner chooses to pursue control of paratuberculosis, the following steps should be taken:

Step 1—Determine the infection rate in the herd. The number of clinical cases of paratuberculosis that develop in a herd each year is a rough indication of herd infection rate. Assuming the clinical cases are infected cows born and raised in the herd (not purchased), for every clinical case of paratuberculosis there are likely to be 5 to 10 cows with subclinical *M paratuberculosis* infection.

The age of animals with clinical disease may indicate the infection pressure in the herd (dose of *M paratuberculosis* to which young animals are exposed). When many of the clinical cases are heifers after delivery of their first calf, there is likely something seriously wrong with the way calves are being raised for replacements replacements, (ie, heavy exposure to infective feces, most often in unclean maternity pens.

The best way to measure the herd infection rate is by use of an objective diagnostic test. The entire adult herd should be tested (all animals ≥ 2 years old). Either a serum antibody test, like ELISA, or fecal culturing could be used. Both tests have sensitivity of about 50% for detecting subclinical infections. Consequently, if 5% of a herd tests positive (apparent prevalence), it should be assumed that twice as many cows in the herd, 10%, are actually infected (true prevalence).

Step 2—Survey the management practices on the farm. Emphasis should be placed on manure management and contact between calves and the adult herd. The degree of hygiene in calving areas, frequency of cleaning the areas, and how promptly calves are removed from the cow are directly related to the probability a calf will become *M paratuberculosis*-infected. Ideally, calves should be raised in an area free of contamination with feces from adult cattle for at least the first 6 months of life.

Feeding of waste milk to calves is a second, often overlooked practice that can transmit *M paratuberculosis*. Use of milk replacer for all calves is a simple solution to the problem; however, colostrum, too, can contain the organism. Routine use of diagnostic tests on the herd can help by identifying cows that are more likely to be infected; then, feeding their colostrum and milk to calves can be avoided.

Step 3—Outline a paratuberculosis control/eradication program consistent with the economic capabilities of the owner and the findings from steps 1 and 2. Several excellent recent reports have summarized paratuberculosis control practices, and most of these recommendations are intuitively obvious.^{3,4} So many recommendations are listed, however, there are too many to be implemented immediately and the herd manager and veterinarian can feel overwhelmed. Consequently, paratuberculosis control practices are listed, starting with those that are most effective and least expensive.

Generally, on most farms, the largest benefits will be realized from changes in calf-rearing practices. This is frequently one of the farm management areas given least attention, and improvements in the hygiene and overall quality of calf rearing will not only minimize *M paratuberculosis* transmission, but will likely decrease several other common calfhood disease problems, such as diarrhea and pneumonia. Prompt removal of calves from cows and housing calves in hutches placed in a dry and well ventilated location on the farm is a simple, easily implemented, and low-cost way to control new paratuberculosis infections on a farm.

Every paratuberculosis-control program should invest in methods to identify and cull infected cows in a herd, in particular those shedding *M paratuberculosis* in the feces. Cattle infected with *M paratuberculosis* shed tremendous numbers of *M paratuberculosis* in the feces, and the organism can remain viable for over a year, depending on environmental conditions. These fecal-contaminated environments are the most common sources of infection for calves.

The choice of diagnostic test is complicated by economic considerations. Because of the different subsidy structure for services at veterinary diagnostic laboratories across the country, it is hard to generalize as to which test is most cost effective. In principle, the best test is one that detects fecal shedders of *M paratuberculosis*. These cattle are in more advanced stages of the disease, more infective, and more likely to transmit the infection to their calves in utero or through their milk. Conventional culture, radiometric culture, and a DNA gene probe are all techniques available to detect fecal shedders.⁵ These techniques are usually more expensive than are serologic tests, and cost in the range of \$8 to \$25/animal.

Of the serologic tests available, ELISA is the least costly and most accurate. It is the most cost-effective means of assessing the herd infection rate, and many, but not all, of the fecal shedders of *M paratuberculosis* will test ELISA-positive. Thus, for a minimal investment or roughly \$4/cow, a herd owner can measure the prevalence of paratuberculosis, then begin to cull the test-positive animals.⁷

For herd owners wishing to make most rapid progress in control of paratuberculosis, the best testing regimen is one that uses ELISA and fecal culturing to detect as many infected cows as possible. The tests could be performed concurrently, or on an alternating basis. Test frequency as short as every 6 months is advocated by some experts, but testing once a year is probably sufficient. The most aggressive test-and-cull program is one in which the test-positive cow and its daughters are culled from the herd.

After the risk of fecal/oral transmission of *M paratuberculosis* to calves is minimized through management changes and a regular test-and-cull program is established, other potential avenues for

M paratuberculosis transmission on a farm should be corrected. The most common problem is fecal contamination of feed for adult cattle by use of common equipment for feces and feed handling or feed bunk designs that allow fecal contamination. Free-stall barns seem more prone to these problems than do stanchion or tie-stall barns. Another potential source of *M paratuberculosis* transmission is drinking from surface waters contaminated with feces from the adult herd. Although adults are considered refractory to *M paratuberculosis* infection, a sufficient dose can probably cause infection and disease.

Before purchase, replacement cattle should be tested by ELISA or fecal culturing and only come from herds that have paratuberculosis test results on the whole herd. It is economically foolish to invest in a paratuberculosis-control program if re-introduction of the infection to the herd is not scrupulously avoided. The risk of buying *M paratuberculosis*-infected dairy cattle is roughly 1 in 10 on the basis of recent surveys. The only reasonable means of reducing this risk is to buy tested cattle, and because of the sensitivity of existing tests for paratuberculosis, it is important to buy only test-negative cattle from herds with no or few test-positive animals. A 1-page article⁸ is recommended as an information sheet for herd owners to explain how to limit the risk of buying *M paratuberculosis*-infected cattle.

Vaccination of cattle against paratuberculosis is not on this list of recommendations. Although it may have served a purpose in the past, recent information indicates it is of limited value in controlling *M paratuberculosis* infections, causes a false sense of security in owners, is a serious health risk for veterinarians,⁹ and prevents use of serologic tests in a herd.

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