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William G. Kvasnicka
University of Nevada, Reno

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William G. Kvasnicka
School of Veterinaxy Medicine
College of Agriculture
University of Nevada, Reno
Reno NV 89557

INTRODUCTION

Weather, nutrition, public land policy, marketing options, and diseases all influence the sustainability and profitability of cow-calf enterprises in the United States. One of the diseases is trichomoniasis. It is a venereal disease of cattle causing reproductive failure and considerable economic loss in areas of the world where natural breeding is used.(1,2) The disease is one of the most common infectious diseases causing decreased reproductive efficiency in beef cattle in the western United States.(1)

THE DISEASE

The cause of bovine trichomoniasis is the protozoan parasite Tritrichomonas foetus. The disease, venereally transmitted, results in infertility and includes early embryonic death, abortion and pyometra.(3) Most abortions occur during the first half of gestation starting 45 days after conception. A few abortions occur as late as the 7th month.(3,4) Persistence of infection follows normal parturition in some cows.(5,6)

In bulls T. foetus is found only on the penis and the preputial membranes. It causes no lesions of diagnostic significance. The infected bull serves only as a carrier of the organism.(5) Older bulls tend to become permanent carriers. The increased number and depth of the crypts in the epithelial lining of older bulls contributes to the persistence of infection.(7)

In cows T. foetus colonizes the vagina, uterus, and oviduct but does not prevent conception.(8) The secretions from these organs contains the parasite. The only observable symptoms are a mild vaginitis and endometritis. The inflammatory response of the uterus occurs 1 1/2 to 2 months after infection by the bull and may be responsible for embryonic wastage. Some cows develop a natural immunity and will conceive and carry a calf to term after three to five heat cycles following abortion. That immunity is not permanent and the cow is subject to reinfection in subsequent breeding periods.(8)

DIAGNOSIS AND PREVALENCE

Herd history and culture of prepucial smegrna or cervical-vaginal mucus aid the veterinarian in making a field diagnosis.(9) Culturing identifies carrier bulls and infected cows but the procedure has repeated sensitivities of 81% to 97%. Thus bulls must be tested three times and heifers five times to assure diagnostic reliability.(10) The organism can be obtained from animals with pyometra or from abomasal contents of fetuses aborted due to trichomoniasis.(11)

Researchers find consistent patterns of placental and fetal lesions due to T. foetus. Recognition of these changes indicate diagnosis of trichomoniasis abortion if proper specimens are not available for culture.(12)

Another diagnostic aid which has recently been developed is the nucleic acid probe (ABI Trich Test - Amipro). Probes should be highly sensitive and specific since they detect specific genetic sequences. Materials for nucleic acid testing do not need to contain living cells or parasites and careful treatment of diagnostic samples is not critical.(13)

An additional diagnostic tool that improves the convenience of testing for trichomoniasis is a system which consists of a small, clear plastic pouch veterinarians use to collect, store, and examine culture specimens for the protozoa. This system is commercially available (In Pouch TF - Bio Med Diagnostics, Inc.).(14)

Infection rates for bovine trichomoniasis vary from 5% to 50%. Idaho regulations require all bulls to be tested for trichomoniasis.(16) The results of Idaho testing indicate that 5.5% to 3% of all herds tested in 1990 and 1991 were infected and the rate of infection within a herd was 10%.(17) It has been found that from 3.25% to 34.6% of bulls in infected herds were infected with T. foetus.(2,18) Infection rates of this magnitude will decrease calf production from 7.6% to 28.6%. (2) Herd infection rates of 30% to 46% have been reported in Nevada.(15) In herds with 20% to 40% of the bulls infected with T. foetus, a reduction of 14% to 50% in annual calf crop occurs and the calving season is prolonged.(19)

CONTROL

Veterinarians and producers have devised control methods based on a general knowledge of how the disease organism is introduced, spreads, and is perpetuated in a herd of cattle. Although the recommendations are sometimes successful, the increase in the disease, especially in the western United States indicates that they are not uniformly successful.(1) The failure of these methods can be traced to several causes:(13)

1. Lack of compliance for testing.
2. Reluctance to test when producers are experiencing drought and a lack of nutritional resources.
3. Animal movements throughout the United States.
4. A lack of a reliable and sensitive diagnostic test.
5. The practice of grazing beef herds in common on public lands.
6. Lack of a safe and effective cow her vaccine.

A vaccine, by raising the resistance of the breeding female and protecting against loss should enhance T. foetus control programs. Vaccines are now available to control Trichomoniasis (Trich Guard - Fort Dodge Laboratories). (15-20) The vaccine protects against abortion by shortening the time a cow is infected following challenge. The resulting protection increases the percentage calf crop by up to 97.1% and shortens the calving season. The vaccine is administered to the cow herd yearly before the breeding season. Two shots are required the first

year to raise the resistance of the breeding herds. In subsequent years the replacement heifers will require two injections of the vaccine and the cows an annual booster.

An effective control program includes the following management practices. These recommendations are based on an understanding of how the disease is spread and on the availability of a safe and effective vaccine that protects the cow herd against the infection and abortion caused by Trichomonas foetus.(21)

- Vaccinate the cow herd yearly before the breeding season.
- Maintain as young a bull battery as possible.
- Culture bulls a month after the breeding season and sell the positives.
- Culture all new bulls purchased.
- Breed virgin bulls to virgin heifers.
- Pregnancy test all cows and heifers 60 days after breeding and cull open females.
- Sell any cows that fail to calve during the subsequent calving season.
- Have fences in good repair to keep stray animals out.
- Don't purchase cull cows.
- Do not use loaner bulls.
- Do not lease bulls.

TRICHOMONIASIS VACCINE DEVELOPMENT AND EFFICACY TRIALS

As early as 1947, scientists were attempting to develop vaccines for bovine trichomoniasis.(22) In 1983 an experimental vaccine developed by Australian researchers showed that the age at which a bull becomes permanently infected can be delayed by approximately one year.(23) Their vaccine was also effective in clearing T. foetus from bulls less than five years of age. Vaccination of bulls older than five years was ineffective.(24)

study of T. foetus isolates from diverse areas of the United States revealed few differences in the antigen profiles identified.(25) Thus it appeared feasible to prepare a vaccine from a single pathogenic strain of T. foetus and evaluate the resulting immunogenicity and protection against T. foetus induced fetal wastage.

Corbeil demonstrated that mucosal surface reactive antibodies not only agglutinate and immobilize T. foetus but also inhibit its adherence to vaginal epithelial cells.(26) All three of these protective functions provide evidence that systemic immunization with T. foetus antigens would protect the bovine reproductive tract against trichomoniasis.

In an immunogenicity trial reported by Schnackel, few or no injection site or systemic reactions occurred. The immunity induced by the vaccine also prevented or greatly reduced T. foetus infection following challenge.(20)

A trial at the University of Nevada, Reno to determine the immunogenicity of a bovine Trichomonas foetus vaccine and the ensuing protection against fetal wastage following challenge was initiated in 1989. Ninety beef heifers from a single source, known to be free of T. foetus,

were randomly assigned to two groups. The groups were designated control and mono. The mono group received two doses, three weeks apart, of a Trichomonas foetus vaccine administered subcutaneously. Each two ml dose of the vaccine contained 5x10 (7) inactivated organisms, along with a Fort Dodge proprietary adjuvant.

On the same vaccination dates, but at separate injection sites, Campylobacter fetus, Clostridium eight way, Leptospirosis-5, H. somnus, killed IBR-BVD and PI-3 vaccines were administered to the mono and control groups. Serum samples were collected from heifers prior to initial vaccination. Additional serum samples were collected 21 days after first vaccination, 28 after second vaccination, 45 days after challenge, and whenever a heifer was eliminated from the study. (Heifers were eliminated at the time of abortion, or at calving.)

Breeding started thirty days after the second vaccinations. The heifers were bred to eight T. foetus infected bulls purchased from Nevada and California ranchers. All bulls used in the trial had received a satisfactory breeding soundness evaluation. The bulls were monitored throughout the forty five day breeding period to assure infectivity. In addition all heifers were infused vaginally with 1 x10 (7) T. foetus organisms within 18 hours of the time estrus was observed.

Thirty five percent of each group was subjected to cervical mucus culture eighteen days after challenge to determine infectivity and to measure protection against infection. Conception was determined by rectal palpation 60 days after breeding. Abortion was detected by rectal palpation every 30 days. Chi-square analysis of variance was used for data analysis.

The reciprocal geometric mean indirect fluorescent antibody titers for the mono group was less than 5 before vaccination, 992 at time of second vaccination and 1,731 twenty eight days post second vaccination. Titers for the control group were less than five for all three samples.

Cervical cultures were 57% positive (N =14) for the mono group and 76% positive (N= 17) for the controls.

Conception rate was 72.5% (N =40) for the mono group and 84.1% (N=44) for the controls.

The abortion rate was 17.2% (N=29) for the mono group and 39.4% (N= 38) for the controls.(Graph 1) This represents a reduction in abortion of 56.4%.

Another immunogenicity trial was initiated in 1990. The materials and methods for the 1990 trial were similar to the 1989 trial except the control group received *Campylobacter fetus-Leptospira canicola grippotyphosa hardjo icterohaemorrhagiae pomona* bacterin and the vaccine group received the latter bacterin containing 5 x 10 (8) T. foetus vaccine at 3 week intervals. The heifers were bred to naturally infected bulls and no additional T. foetus intravaginal infusion challenge was imposed. However an additional challenge was provided by infusion of each bull at the start and again upon completion of a five day breeding cycle. Two

groups of six bulls were used to breed the heifers and they were exchanged every five days. The initial determination of conception for each heifer was performed utilizing the pregnancy specific protein B method.(27)

Following vaccination and prior to challenge by breeding with infected bulls, cervico/vaginal mucus samples were collected for culture of T. foetus. All heifers were culture negative at that time. To assess the ability of the vaccine to prevent infection, ten control and ten vaccinate animals were randomly selected from the test herd and mucus samples for T. foetus culture were collected for 18 weeks following the 45 day breeding cycle. The vaccine appeared to exhibit significant efficacy in preventing infection and in shortening the duration of infection. One week after challenge, 60% of vaccinates were culture positive compared with 80% of controls. The average duration of infection of vaccinates was 3.8 weeks compared to 5.4 weeks of infection for control heifers.

The thirty day pregnancy detection assay showed that 89.2% (58 of 65 heifers) of vaccinates and 85.9% (55 of 64 heifers) of control animals were pregnant. From 60 to 210 days post breeding heifers were examined by palpation at 30 day intervals. Sixty days post breeding, 82% of control and 86% of the vaccinated animals that conceived remained pregnant. Within the next four months the pregnancy rate of control heifers declined to 31% of those that conceived. In the same four month period, over 60% of the vaccinated animals remained pregnant. Significantly, over 62% of heifers vaccinated against T. foetus infection produced calves while only 31% of control heifers bore calves.

These results indicate that the monovalent bovine Trichomonas foetus test vaccine used reduced the fetal wastage attributed to T. foetus infection. This is especially significant in light of the overwhelming challenge attained by the natural breeding of each heifer assigned to the trial to an infected bull, plus the vaginal infusion of live T. foetus parasites shortly following observed estrus.

It is not clear how the systemic antibody titers induced by the vaccine reduces T. foetus infectivity and protects against abortion. Systemic vaccination does stimulate local antibody response.(27) Reports demonstrate increased local anti-trichomonal antibodies in the reproductive tract secretions of infected heifers.(28)

Other studies show that anti-T. foetus antibodies enhanced the killing of the parasite by the alternate bovine complement pathway(29) and prevented adherence of T. foetus to bovine epithelial cells.(26) It appears that vaccine-produced-antibodies may effectively limit T. foetus infectivity. The reduction or elimination of the parasite prior to its ability to cause abortion apparently reduces the fetal wastage associated with bovine Trichomoniasis.

CONCLUSIONS

Closed herds and strict management control can eliminate Trichomoniasis. These approaches do not seem to be feasible for extensively managed beef herds. In any herd, a bull oriented approach to control will probably be ineffective since a small number of animals escape

detection. The carrier cow syndrome will likely continue to perpetuate the disease in infected herds. The chronically infected bull and the carrier cow will continue to threaten non-infected herds. A few infected animals can eventually lead to a large number of infected cows. The associated reproductive inefficiency will reduce the profitability of the cow-calf operation.

Current control strategies effectively lower the challenge in T. foetus infected herds; however, they do not totally eliminate the infection. The results being reported from carefully controlled studies demonstrate that a bovine trichomoniasis vaccine does raise the cow herd's resistance and reduces the fetal wastage associated with infection. In infected herds, or herds threatened by infection, current control strategies to lower the challenge should be combined with a vaccination program to raise the resistance to Trichomonas foetus. This will effectively reduce the abortion rate, shorten the calving season, and improve cow-calf ranching profitability.

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