

Herd and Spatial Factors Affecting the Proportion of False-Positive Results on the Caudal Fold Tuberculin Test in Michigan Cattle

B. Norby, DVM, MPVM, PhD¹; P.C. Bartlett, MPH, DVM, PhD²; J.B. Kaneene, DVM, MPH, PhD²; D.L. Grooms, DVM, PhD²; L.M. Granger, DVM³

¹Department of Veterinary Integrative Biosciences, College of Veterinary Medicine and Biomedical Sciences, Texas A&M University, College Station, TX

²Department of Large Animal Clinical Sciences, College of Veterinary Medicine, Michigan State University, East Lansing, MI

³U.S. Department of Agriculture, Animal and Plant Health Inspection Service, Veterinary Services, Riverside, Washington DC

Introduction

Bovine tuberculosis skin tests have been used successfully for control and eradication of bovine tuberculosis in the United States since the eradication program was begun in 1917. In 1992, there were only 10 states that had not achieved tuberculosis-free status. Unfortunately, bovine tuberculosis has become endemic in the cattle population in certain areas in the United States, including the northern part of the Michigan's Lower Peninsula. The caudal fold test is a key element of herd-level and individual animal screening. The specificity of the caudal fold tuberculin test is not perfect, and has been estimated to be approximately 89-96%. It is also evident that the specificity of the caudal fold tuberculin test is not a constant in different cattle populations. Variation in specificity may be due to differences in the amount and concentration of the tuberculin used for the test, regional variation in cross-reacting mycobacteria that cause false-positive results on the caudal fold tuberculin test, and variation in the interpretation of the test results by the testing veterinarians. The objective of this study was to use available data from the bovine tuberculosis testing program in Michigan to evaluate possible associations between the proportion of false-positive results on the caudal fold tuberculin test, and factors regarding geography and type of herd.

Materials and Methods

In the study population in Michigan, the caudal fold tuberculin test was performed by public or private practicing veterinarians, using an intradermal injection of 0.1 ml of USDA bovine purified protein derivative (1mg/ml) in the caudal fold on either side of the base of the tail. The injection site was palpated approximately 72 hours later, and the test was considered suspect if there was any sign of inflammation. The Michigan Department of Agriculture maintains records of all cattle and herds in Michigan tested with the caudal fold tu-

berculin skin test. Records included a herd identification number, postal address, the date that testing was performed, the number of cattle that were tested, the number of suspect and negative results on the caudal fold tuberculin test, the testing veterinarian and whether or not the whole herd was tested. Between January 1st, 1996 and November 30th, 2001, 8,260 bovine tuberculosis-negative cattle herds (4,223 beef and 4,037 dairy) underwent a 'whole herd test' with the caudal fold tuberculin test. Some herds were tested more than once during this period. All herds were judged to be completely negative for tuberculosis because all cattle were negative on follow-up comparative cervical testing on animals suspect on the caudal fold tuberculin testing.

Inclusion in this study was limited to beef herds with more than 12 cattle and dairy herds with more than 22 cattle, and herds in which the testing private veterinary practitioner had previously tested at least three herds. A negative binomial regression model was used to investigate risk factors for a high false-positive proportion on the caudal fold tuberculin test, including herd type (dairy and beef), agricultural region (n=9) and the four seasons of testing. Spatial clustering of herds with a high proportion of false-positive results on the caudal fold test was assessed using the spatial scan statistic.

Results

Based on the inclusion criteria, 4,989 bovine tuberculosis-negative cattle herds (1,735 beef and 3,254 dairy) were included in the study. The crude mean false-positive proportion in beef and dairy herds was 0.0341 and 0.0558, respectively. In the negative binomial regression model, both herd type ($P < 0.0001$) and agricultural region ($P < 0.0001$) were significantly associated with the proportion of cattle found to be suspect on the caudal fold tuberculin test. Adjusting for herd type and agricultural region, the mean proportion of cattle with

false-positive results on the caudal fold tuberculin test was 0.023 and 0.044 for beef and dairy herds, respectively. The spatial analysis was performed using 1,039 beef and 2,262 dairy herds. The most significant (primary) cluster ($P < 0.05$) was found in the center of Alpena County, and had a radius of 12.1 miles (19.5 km). A total of 759 caudal fold tuberculin test false-positive cattle were observed in this area, and the expected number was 331. An additional 32 less significant (secondary) clusters ($P < 0.05$) were located throughout Michigan.

Significance

Our results may be useful for bovine tuberculosis control efforts by adjusting the observed proportion of suspects on the caudal fold tuberculin test by herd type and geographical location, and hence improving the interpretation of a caudal fold tuberculin test. Also, the results could be used as a quality assurance program to

determine if testers with an unusually low (or high) false-positive proportion test record need to be contacted for retraining in the application or interpretation of the caudal fold tuberculin test. In the current bovine tuberculosis testing program in Michigan, all animals with a suspect caudal fold tuberculin test have to be retested with the comparative cervical tuberculin test within seven days of reading the caudal fold tuberculin test, and animals positive on the comparative cervical tuberculin test will be culled and submitted for mycobacterial culture and PCR. Results of this study make it possible to quantitatively determine whether the observed numbers of caudal fold tuberculin test suspects are significantly different from what would be expected according to herd type and geographical location of the herd. However, this approach should be validated on data including results of the comparative cervical tuberculin test, mycobacterial culture and PCR.

Serum Mineral Concentrations and Risk of Periparturient Disease

R.J. Van Saun, DVM, MS, PhD, DACT, DACVN¹; Amy Todd, BS²; G.A. Varga, PhD²

¹Department of Veterinary Science, College of Agricultural Sciences, Penn State University, University Park, PA

²Department of Dairy and Animal Science, College of Agricultural Sciences, Penn State University, University Park, PA

Introduction

Serum mineral concentrations are very dynamic around the time of calving as homeostatic mechanisms are altered to facilitate transition into lactation or mineral is lost to colostrum formation. If homeostatic control or reserve mobilization are unable to maintain normal physiologic mineral concentrations, a variety of periparturient metabolic diseases may occur. The objective of this study was to evaluate the relationship of serum mineral concentration around the time of calving to animal health status and specific disease conditions.

Materials and Methods

A series of serum samples were obtained from 60 randomly selected mature Holstein dairy cows that had participated in one of two feeding trials. Individual cow serum samples ($n=8$) represented a four-week collection period prior to and following calving, and were analyzed for calcium (Ca), magnesium (Mg), potassium (K), so-

dium (Na), inorganic phosphorus (P), chloride (Cl), zinc (Zn), iron (Fe), copper (Cu) and selenium (Se). Veterinary disease diagnoses were recorded. Serum mineral concentrations and time-based regression coefficients were analyzed by ANOVA (repeated measures for weekly data) with time relative to calving, health or specific disease status and their interaction as main effects and feeding trial as a covariate. Odds ratios (OR) for postpartum disease events were determined using Chi-square contingency tables of defined metabolite concentration categories and health status.

Results

Healthy cows had higher Ca ($P < .001$), Na ($P < .0002$) and Cl ($P < .004$) concentrations pre- and postpartum, and higher Mg ($P = .01$) concentration postpartum compared to cows that experienced one or more disease conditions. Irrespective of time relative to calving, cows with serum Ca concentration below 8.0 mg/dl prepartum or postpartum were at 3.8 (OR, 1.2 to 12.4, 95% CI) and 4.0 (OR, 1.1 to 14.1, 95% CI) times greater ($P = .03$) risk,