

Characterization of Naturally Occurring Coliform Mastitis

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General Project Area Description:

Mastitis remains the most common infectious disease of dairy cattle and the most costly disease affecting the dairy industry. Acute coliform mastitis (ACM), typified by *Escherichia coli* intramammary infection, has become the predominant form of mastitis in herds in which contagious mastitis has been effectively controlled. Despite decades of research focused on ACM, wholly effective control measures have yet to be established and proper treatment of the disease remains controversial. Our understanding of ACM pathophysiology has been based largely on studies of the experimental disease model. These studies typically involved inoculation of a healthy mammary gland with coliform organisms (*Aerobacter aerogenes*, *E coli*, and *Klebsiella spp*) or with purified endotoxin. Results of these experiments suggest coliform bacteria are noninvasive and bacteremia (the presence of bacteria in the circulating blood) is not considered a significant sequela to ACM. Furthermore, disease manifestation has been primarily attributed to the effects of endotoxin. Consequently, it has been widely held that antibiotic therapy is not warranted in cases of ACM. We feel that studies of naturally occurring ACM will help resolve discrepancies between knowledge based on the experimental disease model and practitioner experience in the field.

Projects/Publicatons

Naturally Occurring Acute Coliform Mastitis in Holstein Cattle. Cebra, C.K., Garry, F.B and Dinsmore, R.P., (1996) *J Vet Intern Med.* 10(4):252-257.

A retrospective study of cows with severe clinical signs of disease associated with acute coliform mastitis was performed. Cows in the study were admitted to the Colorado State University Teaching Hospital with a 2 day median illness. *Escherichia coli* was isolated from the blood in 11 of 34 (32%) of cows with coliform mastitis caused by *Escherichia coli*. These findings suggested that a high percentage of cows with severe clinical disease signs are bacteremic and systemic antibiotic therapy may be beneficial in these cows.

Cebra CK, Cebra ML, Garry FB. Hematologic abnormalities over 5 days in cows with acute *Escherichia coli* mastitis. *Bov Practitioner*, 34 (2): 92-97, 2000.

Hematologic data from 45 adult Holstein cows with coliform mastitis and systemic clinical signs were studied retrospectively. They developed panleukopenia that resolved over several days, first through an increase in immature forms and later by an increase in mature neutrophils. Neutropenia lasted three days in most cows. The majority of cows in early lactation did not develop neutropenia for an unknown reason. Cows with fatal disease could not be distinguished based on hematologic analysis because most died early in the disease, while both surviving and non-surviving cows still had panleukopenia.

Cows with coliform bacteremia had prolonged neutropenia and higher metamyelocyte and myelocyte counts during the regenerative phase. These findings suggest that hematologic analysis during the regenerative phase may be useful to identify cows with bacteremia for more aggressive treatment

Wenz JR, Barrington GM, Garry FB, Dinsmore RP, Callan RJ. Use of systemic disease signs to assess disease severity in dairy cows with acute coliform mastitis. *J Am Vet Med Assoc*, 218:567-572, 2001

A prospective cohort study was performed to determine whether a classification scheme based on systemic disease signs could be used to classify severity of disease in dairy cows with acute coliform mastitis. Dairy cows with acute coliform mastitis were examined at time 0 and classified as having mild (n = 69), moderate (44), or severe (31) disease on the basis of rectal temperature, hydration status, rumen contraction rate, and attitude. Results of bacterial culture of milk samples and clinicopathologic testing at the time of initial identification of disease and 48 hours later and outcome were compared among groups. Significant differences in WBC responses and serum calcium concentration were observed among groups. Twenty-eight, 51, and 77 percent of cows with mild, moderate, and severe disease, respectively, had > 100,000 colony-forming units/ml of milk at the time of initial disease identification. The odds that a cow with severe disease would die or be culled were 3.6 times the odds for a cow with moderate disease and 11.2 times the odds for a cow with mild disease. Results suggest that this classification scheme is a simple, rapid method of classifying disease severity in cows with acute coliform mastitis, which may be helping when determining treatment and predicting outcome. Appendix

Wenz JR, Barrington GM, Garry FB, McSweeney KD, Dinsmore RP, Goodell G, Callan RJ. Bacteremia associated with naturally occurring acute coliform mastitis in dairy cows. *J Am Vet Med Assoc*, 219:976-981, 2001.

A prospective cohort study was performed to determine the incidence of bacteremia in dairy cows with naturally occurring acute coliform mastitis (ACM) and a wide range of disease severity. Dairy cows with ACM were examined at time 0 and classified as having mild (n = 69), moderate (44), or severe (31) disease on the basis of systemic disease signs. Results of bacteriologic culture of milk and blood and hematologic testing were evaluated at the time of initial identification of disease and 24 or 48 hours later. Samples from herd mates without mastitis (controls) were obtained at a single time point. Bacteria were isolated from 32% of cows with ACM, compared with 7.1% of control cows. Group 1 isolates of bacteria (*Escherichia coli*, *Pasteurella* spp, *Klebsiella pneumoniae*, *Enterobacter agglomerans*, and *Salmonella typhimurium*) were identified in 14 and 0% of cows with ACM and control cows, respectively. Group 1 isolates were identified in 4.3, 9.1, and 42% of cows with mild, moderate, and severe signs of disease, respectively. *Escherichia coli* and *Klebsiella pneumoniae* were isolated in milk and blood samples obtained from the same cow and were of the same genotype. *Bacillus* spp were identified in 15% of cows with ACM, compared with 1.9% of control cows. Thirty-five percent of cows infected with a group 1 isolate died during the mastitis episode. Results suggested that bacteremia develops in a substantial proportion of cows with ACM. Classification of

severity of ACM is important for establishing effective treatment protocols; parenteral antimicrobial therapy may be indicated in cows with ACM.

Wenz JR, Barrington GM, Garry FB, Ellis RP, Magnuson RJ. *Escherichia coli* isolates serotype, genotype and virulence genes and clinical coliform mastitis severity in dairy cattle. *J Dairy Sci*, in press 2006.

Dairy cattle with clinical mastitis caused by *Escherichia coli*, exhibit a wide range of disease severity from mild with only local inflammatory changes of the mammary gland to severe with significant systemic derangement. The present study was designed to examine the relationship between *E. coli* mastitis isolates the presence of virulence genes and different levels of clinical disease severity and farm from which the *E. coli* strain was obtained. One hundred twenty – eight *E. coli* isolates (123 milk and 5 blood isolates) were obtained from cows with clinical mastitis with varying systemic disease severity from 6 different farms. No predominant serotype was identified by farm or by systemic disease severity, however, the most frequent serotype O158:HNM (n=3), were all isolated from cows in the moderate group. Virulence genes evaluated were identified infrequently and were not associated with systemic disease severity. Evaluation of genetic similarity showed no clustering based on farm or systemic disease severity. We conclude that a high degree of genotypic variability is characteristic of *E. coli* strains causing clinical mastitis within and between different farms and clinical severity groups. Specific cow factors probably play a more important role in determining clinical disease severity.

Wenz JR, Garry FB, Barrington GM. Comparison of severity scoring systems for dairy cattle with acute coliform mastitis. *JAVMA*, vol 299, No 2, July 15, 2006

Cows with ACM were classified as having mild, moderate, or severe systemic disease using 4 classification schemes. One scheme (SSS) was based upon systemic disease signs, another was based primarily on local inflammatory changes (LSS), and an additional 2 schemes (LS1 and LS2) were based upon International Dairy Federation definitions of mastitis severity as previously reported in the literature. Analyses of diagnostic test performance, as well as construction of a receiver operating characteristic plot, were used to evaluate the ability of the 4 schemes to classify cases as a means to identify cows with bacteremia or subsequent death and culling. Twenty-one, 53, 63 and 38% of cows were classified with severe disease by the SSS, LSS, LS1 and LS2 schemes respectively. SSS had the best specificity for identifying cows with bacteremia (0.84) and those that died or were culled (0.86). LS2 was more sensitive than SSS for identifying cows with outcomes of bacteremia or death and culling; however LS2 was less specific for both outcomes. The positive predictive value and test efficiency was highest for the SSS and lowest for the LSS schemes.

Conclusions and Clinical Relevance— Results of this study suggest that classification schemes evaluating the extent and degree of systemic disease signs in cows with ACM could be used to direct appropriate management directed at adverse outcomes.

Wenz JR, Lombard JE, Elia R, Prentice D, Garry FB, Dinsmore RP. Efficacy of parenteral ceftiofur for treatment of systemically mild clinical mastitis in dairy cattle. *J Dairy Sci*, 2005;88:3496-3499.

The objective of this study was to evaluate the effect of intramuscular (IM) ceftiofur (2.2mg/kg) on important outcomes of systemically mild clinical mastitis episodes in lactating dairy cattle. Cows with clinical mastitis were randomly assigned to a treatment group: pirlimycin intramammary (IMM) (n=35), pirlimycin IMM and ceftiofur IM (n=36), cephalixin IMM (n=40), cephalixin IMM and ceftiofur IM (n=33). Sixty-nine, 22 and 9% of initial cultures were gram negative, gram positive and mixed, respectively. Logistic regression analysis showed no significant associations between treatment groups and loss of quarter, recurrence or culling. Mixed infections, positive milk culture at 7 d after leaving hospital pen, decreased rumen motility and absence of udder firmness were associated with increased odds of mastitis recurrence. The results suggest IM ceftiofur treatment has no beneficial effects on outcome of systemically mild clinical mastitis.

Other Publications:

Abstracts:

Activity of selected antimicrobial agents against strains of *E. coli* and *Klebsiella* spp. isolated from bovine intramammary infections. Wenz JR, Salmon SA, Robb EJ, Garry FB, Barrington GM. Proc. National Mastitis Council, 2nd International Mastitis Symposium, p548-549, 2001.

Use of a cow-side antibiotic susceptibility test to predict gram staining characteristics of clinical mastitis pathogens of dairy cattle. Wenz JR, R Elia, FB Garry. Am Assoc Bov Pract Proc 36:178, 2003.