Antibody Responses and Clinical Outcome Following Naturally Occurring Cases of Clinical Mastitis Compared Among J5 Vaccinates and Controls

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Introduction

Mechanism(s) of J5 vaccine immunity, including the relative importance of J5-specific antibodies, have never been conclusively determined. This study evaluated the association of a two-dose J5 vaccination program with production of anti-J5 antibodies and measures of outcome for naturally occurring clinical mastitis (CM).

Materials and Methods

Three Holstein dairy herds were studied. Milk production was approximately 25,000 pounds per cow per lactation and contagious mastitis was well controlled. Cows that met inclusion criteria were randomly assigned as J5 vaccinates or controls. The vaccine was administered subcutaneously in the supramammary region at dryoff, and again 21-28 d before the calving due date. Milk samples were aseptically collected for microbiological culture at onset of any cases of CM. Blood samples were collected from all cows at drying off, 1 - 7 DIM following calving, and once between 17 – 77 d following the end of treatment for all CM cases. This study used a subset of cows, from the 2 herds with 97% accuracy of cows' daily milk weights recorded electronically, and with CM cases defined as either Severe or Mild. Comparing mean milk production for the 14 d before onset of CM to that of the 21 d after end of treatment, Mild cases were defined as those that had > 100% of pre-mastitic production. Severe cases had < 85% of pre-mastitic milk production, or were culled or died < 30 d after onset of CM and < 150 DIM when culled or died. Antibody against J5 was measured by ELISA at Michigan State University.

Results

There were 51 CM cases selected for antibody testing, 32 Severe (17 controls, 15 vaccinates) and 19 Mild (7 controls, 12 vaccinates) cases. 28 Severe cases had milk production < 85% of pre-mastitic production after CM and the other 4 Severe cases were culled. Post-calving IgG1 ($P < 0.01$) and IgG2 ($P < 0.05$) against J5 were higher in vaccinates. All 3 classes of J5-specific antibody were not different between vaccinates and controls 17-77 d following CM. J5-specific IgM and ratios of IgG1:IgG2 were not significantly different among controls and vaccinates at any time point. Logistic regression (85.7% Concordant pairs) showed that as DIM at onset increased, severity was more common, especially among J5 vaccinates (interaction of DIM x vaccination) ($P < 0.03$). Linear regression showed that less milk production was lost for cases with onset earlier in lactation ($P < 0.0001$), in J5 vaccinates only among cows infected with E. coli (interaction, $P = 0.02$), and with post-calving ($P = 0.06$) and post-mastitic ($P = 0.01$) IgG1 values in moderate ranges compared with extreme high or low values. 83% of J5 vaccinates had post-calving IgG1 in the beneficial range, while 63% of controls did, a nearly significant difference ($P = 0.06$, Fisher's Exact Test). The hazard of being culled for all reasons was less for J5 vaccinates (44%) than for controls (64%), and vaccinates were especially less likely to be culled during early lactation ($P < 0.05$, time to event analysis). These cull rates are high because all Severe cases were included in this subset of cows. Hazard of culling with mastitis as the reason was also significantly less for vaccinates (4%) vs. controls (23%) ($P < 0.03$). Hazards of dying were not different among vaccinates and controls. Pathogens isolated did not differ between Severe and Mild cases.

Significance

J5 vaccination was associated with protection against effects of CM, especially in early lactation cases with E. coli. Following CM, controls were similar to vaccinates in increased antibody production, but vaccinates were protected by more IgG1 and IgG2 (memory immunity) against J5 before the disease. Antibody class (isotype) switching from IgM to IgG1 and IgG2 appears to be an important mechanism of J5 protection. Vaccine protection decreased as lactation progressed. The optimum J5 vaccination schedule for the most cost-effective protection (better immunological memory) against clinical mastitis should be further investigated.