Field Efficacy of J-VAC Vaccines in the Prevention of Clinical Coliform Mastitis in Dairy Cattle

Norman Habermehl, DVM, MBA, and Bruce Wren, DVM, PhD

The Bottom Line

- Coliform mastitis has an average incidence rate of 15% to 20% in herds with low somatic cell counts (SCC) and is implicated in 30% to 40% of clinical cases. It is a common cause of fatal mastitis in cattle.

- The control of coliform mastitis is difficult, unreliable and frustrating in spite of the existence of apparently excellent management, and control should be focused on the prevention of new intramammary infections.

- J-VAC is licensed for the vaccination of healthy cattle as an aid in protection against mastitis caused by Escherichia coli and the effects of endotoxemia caused by E. coli and Salmonella typhimurium.

- Cattle vaccinated with J-VAC had a significant reduction of 81% in clinical coliform mastitis (P<0.001)

- J-VAC can be a cost-effective management tool when clinical coliform mastitis (CCM) rates are more than one case per 100 lactations (1% lactational incidence rate).

Introduction

Coliform mastitis has been reported worldwide, the result of E. coli, Klebsiella spp., and Enterobacter aerogenes bacteria from the environment entering the mammary gland as an opportunistic invader. Eighty to 90% of these coliforms result in varying degrees of clinical mastitis, with 8% to 10% resulting in severe, systemic mastitis within the first weeks after calving.

Fecal contamination of bedding has been associated with coliform mastitis caused by E. coli, while coliform mastitis caused by Klebsiella spp. is associated with wet sawdust and wood shavings.(1) Coliform mastitis has an average incidence rate of 15% to 20% in herds with low somatic cell counts (SCC) and is implicated in 30% to 40% of clinical cases. It is a common cause of fatal mastitis in cattle.(1)

The control of coliform mastitis is difficult, unreliable and frustrating in
spite of the existence of apparently excellent management. In the control of coliform mastitis, the emphasis is on the prevention of new infections. The vaccination of cows during the dry period and early lactation with an \textit{E. coli} J5 vaccine has been demonstrated to be a practical management aid to reduce the incidence and severity of clinical coliform mastitis.\cite{1}

The objective of this field trial was to demonstrate the efficacy of a-dose vaccination programs with J-VAC vaccine, a commercially available J5 \textit{Escherichia coli} bacterin-toxoid, for controlling clinical coliform mastitis (CCM) in lactating dairy cattle.

\textbf{The Field Trial}

A total of 731 dairy cows from four well-managed commercial Holstein herds was used in this trial. Each animal was randomly assigned to either the group that was vaccinated with J-VAC vaccine or a placebo treatment group. The cows in this study were of various age, parities and levels of milk production. Prepartum heifers were also included in the study. Herd owners, individuals collecting milk samples and the laboratories utilized for milk culture were not aware of the treatment group of any animal until the completion of the trial.

A dry-cow vaccination protocol was utilized in two herds involving 203 cows. The cows received the initial dose of J-VAC or placebo at the beginning of the dry-off period, with the second dose being administered 1 to 3 weeks prior to calving. Heifers in these trials received an initial vaccination of J-VAC or placebo when estimated to be 7.5 months in gestation, with the second injection being given 1 to 3 weeks prior to calving. The vaccines were administered according to label directions and the trial was conducted over a period of 10 and 15 months.

A whole-herd vaccination protocol was utilized in two other herds involving 530 lactating dairy and late gestational heifers. The initial J-VAC or placebo injection and subsequent second injection were given one month apart. These trials were conducted over a period of 4.5 months.

Throughout the trials, all cases of clinical mastitis (identified by the milkers/herd managers) were defined by the presence of abnormal milk, udder inflammation and/or systemic disease. Prior to treatment, milk samples were aseptically collected and submitted to a bacteriology laboratory for culture and identification. All bacterial isolates from the clinical mastitis cases were identified biochemically. A quarter was diagnosed as having CCM if a pure culture of a coliform organism (\textit{E. coli}, \textit{Klebsiella} spp., \textit{Enterobacter} spp., \textit{Serratia} spp.) was isolated and identified from milk samples collected from clinical cases of mastitis.

\textbf{Overall Results}

Subsequent to initial vaccination and booster injections, no abnormal local or systemic responses to vaccination were recorded in any of the animals involved in this trial.
The clinical mastitis data from these trials were pooled and analyzed. There were 64 cases of clinical mastitis during this trial, representing a clinical mastitis incidence rate of 8.73% (Table 1).

Coliform bacteria were isolated and identified from 24 clinical mastitis cases (37.5%). The aggregate clinical coliform mastitis (CCM) incidence rate was 3.27%. The group of 374 animals vaccinated with J-VAC experienced 4 CCM cases (1.07% incidence rate). The cattle vaccinated with J-VAC had a significant reduction of 81% in the incidence of clinical mastitis attributable to coliform intramammary infections ($P<0.001$).

<table>
<thead>
<tr>
<th>Group</th>
<th>Number</th>
<th>#Herds</th>
<th>Protocol</th>
<th>CCM</th>
<th>Incidence Rate</th>
<th>PVRF*</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>733</td>
<td>4</td>
<td>dry-cow and whole- herd</td>
<td>24</td>
<td>3.27%</td>
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<td></td>
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<tr>
<td>J-VAC</td>
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<td>4</td>
<td>dry-cow and whole- herd</td>
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<td>1.07%</td>
<td>&lt;20%</td>
<td>$P&lt;0.001$</td>
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<tr>
<td>Placebo</td>
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<td>20</td>
<td>whole-herd</td>
<td>20</td>
<td>5.57%</td>
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*PVRF: Post-vaccination risk factor=(1- reduction in incidence).

<table>
<thead>
<tr>
<th>Group</th>
<th>Number</th>
<th>E. coli</th>
<th>Incidence Rate</th>
<th>PVRF*</th>
<th>P-value</th>
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<tbody>
<tr>
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<td>12</td>
<td>1.64%</td>
<td>&lt;20%</td>
<td>$P&lt;0.02$</td>
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<td>J-VAC</td>
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<td>0.53%</td>
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<tr>
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<td>359</td>
<td>10</td>
<td>2.79%</td>
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<td></td>
</tr>
</tbody>
</table>

*PVRF: Post-vaccination risk factor=(1- reduction in incidence).

*Escherichia coli* was isolated from 12 cases of CCM during the trial, two from the 374 head vaccinated with J-VAC and 10 from the 359 head placebo-injected group (Table 2). The incidence rate was 0.53% and 2.79% respectively. Again, the data clearly demonstrate a significant reduction of 81% in the incidence of CCM caused by *E. coli* intramammary infections ($P<0.02$).

**Dry Cow Protocol Results**

In total, 109 of 203 head were vaccinated with J-VAC following a dry-cow vaccination protocol. None of the 109 animals vaccinated with J-VAC, while 7 of the 94 placebo-injected animals developed CCM during the trial. All of the coliform isolates were identified as *E. coli*.

These data demonstrate that a dry-cow protocol administered at, or near, dry-off, and boostered 1 to 3 weeks prior to calving, significantly reduced...
the incidence of CCM ($P<0.005$).

**Whole-Herd Protocol Results**

A whole-herd vaccination protocol was used in 530 head. Three of 265 animals vaccinated with J-VAC and 13 of 265 placebo-injected animals developed CCM during the trial. These data demonstrate that a whole-herd vaccination protocol, significantly reduced the overall incidence of CCM by 76.9% ($P<0.025$).

**Discussion**

In this trial, two herds were vaccinated with a "dry-cow" vaccination program and two herds were vaccinated with a "whole herd" vaccination program. Both programs effectively, and significantly reduced the incidence of clinical coliform mastitis in lactating dairy cattle (>80% and 76.9% respectively).

The overall reduction in incidence of CCM is consistent with previous reports in the scientific literature. In these reports, were an experimental-mutant J5 *E. coli* bacterin toxoid incorporating Freund's incomplete adjuvant, given twice in the dry period and a third dose given within 14 days of calving reduced the incidence rate of CCM by 80%.(2) In other words, dairy cows vaccinated with the experimental J5 *E. coli* bacterin-toxoid had a post-vaccination risk of 20%, compared to non-vaccinated animals.

An independent economic analysis, based upon reported literature results, concluded that implementation of J5 bacterin-toxoid vaccination programs would be cost-effective whenever herds experienced CCM at rates above 1% of lactations.(3)

This trial clearly demonstrates that the 2 dose J-VAC program is equally effective as the 3-dose experimental J5 bacterin-toxoid program vaccine in reducing the incidence of CCM. A 2-dose vaccination program offers considerable advantages to dairy producers by reducing the number of vaccinations required and eliminating the need for vaccinating post-calving dairy cows that are immuno-suppressed as a result of a negative energy balance and high levels of endogenous corticosteroids.

**Conclusions**

J-VAC is a cost-effective management tool that will greatly benefit mastitis control efforts in dairy herd that experience, or are likely to experience, CCM rates greater than one cow per 100 (1% lactational incidence rate).

J-VAC is licensed for the vaccination of healthy cattle as an aid in protection against mastitis caused by *E. coli* and the effects of endotoxemia caused by *E. coli* and *Salmonella typhimurium*.

**References**
