Eliminating *Staphylococcus aureus* Intramammary Infections Using Immune Enhancement and Antibiotic Therapy

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Staphylococcus aureus intramammary infections are difficult to treat and eliminate from lactating cows. Antibiotic therapy during lactation has often resulted in poor cure rate of less than 10% and has not been considered economically sound.[5] Lack of success with antibiotic therapy has been attributed to susceptibility, inaccessibility of the organisms, limited exposure to antibiotic, and poor immune function. The use of multiple antibiotic treatments demonstrate marginal in cure of 38%, with greater responses when milk somatic counts were less than a 1,000,000 cells/ml.[1] Since somatic cell response at time of therapy affects bacteriologic clearance, it might be possible to optimize the animal immune response to assist in this bacteriologic clearance.[1] Staphylococcal vaccines have been most successful when highly encapsulated strains of *S. aureus* were used.[3,4] These vaccines provide good cross activity between strains and have been used to reduce new infections in heifers. Although these preparations have been successful in preventing new infections, vaccination has not been successful in eliminating existing infections.[2] Most bacterins do not produce lasting antibody levels, but if timed with antibiotic therapy, the animal's immune status might be optimize to enhance bacteriologic clearance. This clinical trial was designed to incorporate immune enhancement and antibiotic therapy.

Methods

Twenty eight *S. aureus* infected cows from a dairy of 48 cows were selected by quarter milk cultures of the herd. Three cows were removed from the herd based on low milk production, not pregnant or far from calving with low herd value; Five cows were dried off following vaccination with experimental staphylococcal bacterin, treated with lactating antibiotic intramammary treatment followed by a nonlactating antibiotic intramammary treatment. The eleven remaining infected cows were treated with intramammary antibiotic following vaccination with an experimental staphylococcal bacterin.

Immune Enhancement: A killed staphylococcal bacterin was prepared from an encapsulated strain of *S. aureus* and a selected hemolytic field strain from the herd. A concentrated solution of formalized *S. aureus* was suspended in an AlOH-oil base. Cows received three subcutaneous inoculations in the region of the supramammary lymph node. Each cow received 5 ml of Sel/vit E (25mg/1500 IU) and 5 ml of Vital E (1500mg) subcutaneously at the first and second inoculations.

Vaccination schedule: 1st inoculation - 2 weeks before treatment with IMI antibiotic; 2nd inoculation - 48 hours pretreatment; 3rd inoculation - 7 days after the second inoculation.

Sample Collection Procedure: Quarter milk samples were collected aseptically from each lactating cow for 12 months prior to vaccination and treatment and monthly data collected for 12 months. Samples were collected from each of the *S. aureus* infected animals prior to assignment into categories, at each vaccination period, prior to treatment and 7, 14, 21, 28 days, and monthly (except during the dry period). Isolation of *S. aureus* in any of the culture collected after the 7 day posttreatment was consider a failure to eliminate the infection. Milk somatic cell count (SCC)was collected from each quarter of infected cows, and DHIA-SCC were evaluated.

Treatment Protocol: Animals received 3 sequential courses of pirlimycin hydrochloride in accordance to the manufacturer's instructions. The suggested withhold-

ing time was used as the interval between courses. The first treatment was administered 36 hrs after the second inoculation.

Economic Analysis: Value of the program was determined by comparing the losses for cows with *S. aureus* to the herdmates by the calculated somatic cell count and ME difference. Cost of the program included: 1) cost of culturing to identify infected animals, 2) loss to culling, 3) cost of vaccination and treatment. No value was assigned to the value of a *S. aureus* herd and potential exposure to other cows.

Results

Staphylococcus aureus was isolated from 33 quarters of 15 cows with DHIA-SCC of 492,000 (LS 5.3) prior to initiating the *S. aureus* reduction protocol. Three cows were selected for removal because of low economic value, four cows grouped for dry cow therapy and eight cows vaccinated and treated with pirlimycin lactation therapy. All but three quarters responded to the antibiotic therapy for both the dry cow group and lactation group. One quarter of one cow from the dry group was (March 1997) included into the lactation group and one of the lactating cows was (November 1996) included into the dry cow group. Staphylococcal infections were eliminated from the herd been August and December, 1996 and the herd remained clear of *S. aureus* through July 1997. DHIA-SCC decreased from 492,000 to 84,000 cells/ml over the same time period (Table 1).

Table 1. Herd summary of cow before and following initiation of a vaccination- treatment program.

Date	Cows	Somatic Cell Count			Cultured Intramammary Infections					
		Linear Score	Cells/ml x 1000		Total	*Staph aureus*	*Staph sp*	*Strep sp*	*C. bovis*	*E. coli*
Aug 95	48	5	400	cow	36	17	13	2	3	1
				qtr	**63**	**31**	**22**	**3**	**6**	**1**
Aug 96	48	5.3	492	cow	28	15	9	1	2	1
				qtr	**56**	**33**	**17**	**1**	**4**	**1**
Dec 96	49	3.1	107	cow	12	0	4	2	4	2
				qtr	**15**	**0**	**4**	**2**	**7**	**2**
Mar 97	56	2.8	87	cow	14	1	6	2	3	2
				qtr	**18**	**1**	**9**	**2**	**4**	**2**
July 97	63	2.7	84	cow	15	0	11	2	2	0
				qtr	**19**	**0**	**15**	**2**	**2**	**0**

Summary

It is both possible and economically sound (Table 2) to use lactating therapy combined with immune enhancement to develop a mastitis control strategy to eliminate *S. aureus* from lactating dairy cows. Although selective removal of low value cows and utilizing the dry period can be an important part of any mastitis control plan, it is not necessary to use these management practice as the sole means of eliminating *S. aureus* in the herd.

Table 2. Economic impact of *S. aureus* elimination program.

Cost of Program		Herd
Herd culture to ID infected cows	50 cow @ $3.00 twice	$300.[a]
Lactation therapy	24 tubes @ $3.00	792
Vaccination	16 *S. aureus* cows	100
Dry cow therapy	5 cow (lact +dry therapy)	410
Milk loss for residue withdrawal	12.00 cwt for 80 lb/day	1054
Cull	3 cow @ $600 loss/animal	1800.[a]
Total		**$2656**
Cost per cow	16 cows treated	**$166**
Income Savings		
Milk gain based on SCC-LS	LS 5.3 to 2.8	$5376*
Milk gain based on ME for *S. aureus*	Infected vs herdmates	$6846**
Reduced culling for *S. aureus*	6 cows @ $600	$3600.[b]
Total		**$8976* - 9446****

[a] Cost varies with size of herd and animals removed for low economic value
[b] Animals removed in 1995 with *S. aureus* infection for low economic value

References

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