Klebsiella Mastitis as a Herd Problem

Louis E. Newman, *D.V.M.*
Veterinary Medicine Extension
Michigan State University
East Lansing, Michigan 48824

The common causes of mastitis include both gram positive and gram negative bacteria. The gram positive bacteria probably account for 95% of the infections. The most common of these is *Streptococcus agalactiae* which is responsible for over 50% of the new infections. *Staphylococcus aureus* probably is responsible for 15-25% of the mastitis cases caused by infectious organisms. The environmental streptococci (*Streptococcus uberis* and *Streptococcus dysgalactiae)* account for about 15% of the infections.

The remaining 5% of the infections are important because of the severity of the clinical cases they cause and the economic impact upon the dairy herd in which they become a problem. The coliforms are the gram-negative bacteria which are currently causing some of our most serious problems.

The coliform bacteria include *Escherichia coli, Klebsiella* sp., and *Enterobacter* sp. This discussion centers upon the problem of *Klebsiella* mastitis in Michigan dairy herds.

The coliform bacteria are widespread in the environment of dairy cows. *E. coli* can readily contaminate the teats and udder of a cow because it lives in large numbers in the manure and in polluted or contaminated water. *Klebsiella* is normally found in the soil and on vegetation. It, too, may be found in a number of places in the environment of the dairy cow. Both of these organisms are gram-negative bacilli. The dramatic clinical signs which they produce in the dairy cow are the result of the production of endotoxin by these organisms in the udder of the cow.

Klebsiella mastitis most often occurs in the well managed, high producing herds. Most of these herds are teat dipping and dry cow treating and are experiencing a low incidence of *Strep.* and *Staph.* infection. All of the Klebsiella herd problems seen have occurred in herds in which the bedding was sawdust. Herd outbreaks, or "storms" of *Klebsiella* mastitis cases, have seemed to be related to predisposing factors such as inclement weather or the addition of new sawdust bedding. The cows affected have been the highest producing cows at the peak of lactation. These cows usually have low leucocyte counts and are *Strep.* and *Staph.* free.

In many cases the cow will be normal at one milking and in serious trouble 12 hours later. The involved quarter is likely to be very hard and markedly swollen. The secretion from this quarter is yellow and serous in character. The other three quarters produce very little milk. The cow often has a fever between 106 and 108°F. Some of these cows die within 12-24 hours. Others go down and clinically resemble milk fever. Many of the cows dry upcompletely and loose 300-400 pounds over the next 3-6 weeks. In those herds where the owner has learned to recognize these cows early, so that they can be treated prior to the severe clinical manifestations, the cows may return to production. We estimate that 10-20% of the cows affected with *Klebsiella* mastitis die, and that only 10-20% return to production in the lactation during which they were affected.

When looking at the mammary gland of a cow which died as a result of *Klebsiella* mastitis we note a tremendous inflammatory response and large white areas of tissue necrosis as a result of the endotoxin.

There is no one treatment which has proven most satisfactort in the hands of all practitioners. We have been using oxytocin to help us remove as much of the endotoxin from the quarter as possible. We have also been using relatively high levels of cortiocosteroids to combat the effect of the endotoxin (100 mg. of dexamethasone I.M.). Most antibiotics have not been particularly beneficial in our hands. Although it is not approved for use in food-producing animals by the FDA we are using gentamicin on a prescription basis because we feel it is life saving. We feel that an intramammary dose of 100 mg. (2 cc.) of gentamicin is most effective. We most often add 100 mg. of gentamicin to a commercial product containing 100,000 units of penicillin at the time of infusion. Gentamicin must not be mixed with penicillin in advance of its use since mixing results in inactivation of both drugs. Should these cows return to production the minimum withholding time for the milk is 120 hours. Gentamicin is given intramuscularly at a dosage of 2 mg. per pound of body weight in septicemic cases in which we feel systemic antibiotics are indicated. This dosage is required to obtain satisfactory blood levels. It is usually repeated at 12 hour intervals. Antihistamines, fluids and electrolytes are also indicated in many cases.

Surprisingly, most of these cows will return to normal production from all four quarters in future lactations. In most cows affected with *Klebsiella* mastitis the swelling subsides completely and little or no scar tissue results from the infection.

The herd problems we are discussing differ from the single acute case in that most of them involve a number of cows at the peak of lactation. Single cases usually occur within two weeks of calving. In the herd

problems which we have investigated, many of the milk samples have been positive for *Klebsiella* when the entire herd has been sampled. In every herd problem investigated to date the bedding has been sawdust.

Herd A experienced severe coliform mastitis in storms. Sixty percent of the samples cultured from this herd were positive for *Klebsiella* species. In an attempt to clear up the problem all of the sawdust was removed from the free-stalls. The free-stall barn was cleaned and disinfected. Then fresh sawdust bedding was placed in the free-stalls. All of the positive cows were treated and the three cows which remained positive in spite of treatment were sold. All of the sawdust bedding was removed and fresh bedding placed in the free-stalls at three-month intervals. The herd was resampled and cultured at six months at which time 60% of the samples were again positive for the presence of *Klebsiella*. However, it was almost one year later before the first recurrence of clinical cases. At this time all of the sawdust bedding was removed and the bedding changed to sand. No problem has been encountered since.

Herd B lost the production from five top cows during a three-week period of time. Two of these cows died during the first 24 hours of illness. *Klebsiella* was isolated from the milk samples from 56% of the cows in this herd. The bedding in the stanchions was changed from sawdust to straw and the bedding in the free-stalls was changed to sand in an attempt to decrease the incidence of *Klebsiella* mastitis. At the end of three months only 9% of the milk samples taken from this herd were positive for *Klebsiella* and at the end of six months there were no milk samples from which *Klebsiella* was isolated. No *Klebsiella* mastitis cases have occurred in this herd since the bedding was changed.

We collected bark and wood samples from live trees in Southern, Central, and Northern Michigan in an attempt to determine the source of the *Klebsiella* organisms. None of our samples from live trees were contaminated with *Klebsiella*. We believe that the logs become contaminated by skidding through soil and vegetation during the logging process.

Ten percent of the samples which we took from the logs stacked at sawmills in Michigan were contaminated with *Klebsiella* species.

Most of the sawmills in Michigan are equipped with a debarker. Ninety percent of the samples of material we took which came from the debarkers were contaminated with *Klebsiella* species.

The debarked logs then enter the sawmill and are placed on the cradle for sawing. The sawdust from this operation is most often blown into a pile, although it may be collected in a bin and be hauled away the day it is produced. Fifty percent of our samples from sawdust piles and sawdust bins were contaminated with *Klebsiella* species.

When we burrowed down into these sawdust piles we found the sawdust sterile above a temperature of 50°C (140°F). This has led some to conjecture that old or heated sawdust might be a better source of bedding than fresh sawdust. We do not have the answer to this. Perhaps it would depend upon the likelihood of recontamination of the sawdust from the exterior portions of the pile or the degree to which alterations might have occurred in the sawdust which would influence the growth of bacteria in that sawdust.

Contaminated samples is one of the most difficult problems with which we deal in attempting to determine whether or not a herd is experiencing a *Klebsiella* mastitis problem. Quite often we are faced with a situation where someone is attempting to diagnose the problem in an entire herd on the basis of one or two samples submitted from acute clinical mastitis cases. Many of these samples will be negative upon culture because of the presence of antibiotics or because those bacteria remaining have been engulfed by leucocytes, and there will be no growth of pathogens on the blood agar plate.

In one herd of 87 cows in which a single acute clinical case had been diagnosed as *Klebsiella* mastitis we cultured *Klebsiella* from 65 of 87 samples submitted to the laboratory. Since this appeared to be an ideal herd in which to do a research project, I went out to the herd to collect another series of samples. We were unable to culture *Klebsiella* from a single sample which I took. Sixty-five of the previous set of samples had been contaminated. This case is perhaps extreme, but characteristic of the type of problem that occurs. In herds bedded on sawdust this organism is widespread in the environment of the cow and on the udder and teats of that cow. Unless the samples are taken in an aseptic manner they can be very misleading. Two out of three of the herds in which I am asked to help because of a *Klebsiella* mastitis herd problem proves to be something other than *Klebsiella*, most often *Strep. non-ag.* or *Staph.*

Bulk tank samples are not of value in determining whether or not *Klebsiella* is involved in a herd mastitis problem. *Strep. ag* and *Staph. aureus* are the only two organisms, when isolated from the bulk tank, that result in your feeling fairly certain that they came from the cows. All other organisms are probably contaminants, and this would include *Klebsiella*.

The point I want to bring home is that single samples from acute cases and owner sampling resulting in contamination may be very misleading when you are attempting to diagnose the primary cause of a herd mastitis problem. We like to leave sterile tubes with the client in these cases. We prefer that he collect two samples from those cows with clinical cases of mastitis. We normally show him how to collect the samples or see to it that he has a written description of the method of collecting samples. Where it is feasible, we prefer that the samples be collected prior to milking and again post-milking. When this is not feasible, we ask the client to collect two samples before he does anything else. If it is not

feasible to submit the samples from each case immediately to the laboratory, we may ask the client to freeze the samples and submit them to us at two week intervals. Four out of five or seven out of ten samples from which we isolate the same organism are far more indicative of the herd problem than the results obtained from a single sample.

A number of statements have appeared in print which have suggested that *Klebsiella* mastitis is related to hardwood sawdust. We are aware of a number of problems which have occurred where the cows were bedded on pine sawdust. In our laboratory pine sawdust grew the organism very well. Cedar was resistant.

We do not recommend that all dairymen change from sawdust to some other source of bedding. We think sawdust is one of the best bedding materials for dairy cows. It also has been particularly advantageous for some dairymen and the use of sawdust as dairy cow bedding has benefitted the wood products industry.

In those herds where we have made a definitive diagnosis of a *Klebsiella* mastitis problem, we have recommended that they change to a different type of bedding. We have never seen a *Klebsiella* mastitis herd problem on sand, crushed limestone, straw, chopped hay or kiln-dried shavings. In the few herds where, because of their manure handling system or other factors, it is impossible or unfeasible to change types of bedding, disinfection or sterilization of the sawdust may be indicated. In two herds our clinical impression was that by dumping a shovelful of lime on top of the sawdust in the back of each free-stall once a week we were able to control the *Klebsiella* mastitis problem. In other herds where we attempted to mix lime with the sawdust we did not feel our results were satisfactory. Paraformaldehyde pellets have been tried by others and show some promise. We have no research data to back up these impressions and additional work on the disinfection or sterilization of sawdust is needed.

We have used an autogenous bacterin in some herds and the clinical impression is that it is helpful. Vaccination needs to be repeated at six-month intervals. Clinical cases usually recur if the vaccination interval is allowed to reach one year or longer. Again, there is no research evidence to indicate that the autogenous bacterins are definitely effective.

Feed should be available when the cow leaves the milking parlor. There seems to be an advantage to keepi,g the cow on her feet following milking during the period of time that the teat canal sphincter is contracting. Where herd problems exist, a careful exa.ination of the milking system is indicated. A dry udder is basic to good udder health. In those herds that do not dry the udder following udder washing, often times simply introducing the use of individual paper towels can markedly decrease the incidence of mastitis caused by environmental pathogens. Teat dipping should be accomplished immediately upon removal of the milking machine.

Although Klebsiella mastitis is the only mastitis problem that we have associated with the use of sawdust bedding, I think we should be aware of the fact that we also isolated a number of other gram-negative bacteria from our samples.

And, finally, this brings us to the area of conjecture–wondering just what role sawdust, or *Klebsiella,* organisms might play in other conditions which we see in our domestic livestock. Cows which calve on sawdust certainly are going to carry some sawdust into the uterus during the calving process. To what extent might *Klebsiella*, or others of the gram-negative bacteria which are present in sawdust, play a role in postcalving metritis, particularly in those dairy animals which are prone to post-calving disorders. In fact, we now recommend that our dairymen place straw in the maternity stalls. We have experienced *Klebsiella* mastitis and *Klebsiella* metritis in sows that were bedded on sawdust. Is it possible *Klebsiella* mastitis and the resultant endotoxin production in as few as one or two mammary glands might play a role in the etiology of the condition we call MMA? And what about metritis and cervicitis in mares?

Mastitis Therapy: Effective Treatment or Double Trouble

***Mastitis Treatment Committee National Mastitis, Council, Incorporated**

1. **Coliform Mastitis! What do you use?** FDA regulations are such that a drug cannot be approved for use for lactating animals if the withdrawal period exceeds 96 hours. Most drugs which would be effective against gram negative organisms are, therefore, not available to treat coliform mastitis. Here is one approach to treatment:

*This information was supplied by Dr. Louis E. Newman

a. Oxytocin
   1. Strip out the quarter: remove as much endotoxin as possible.
b. Corticosteroids and fluids to combat the effects of endotoxin.
   1. High doses of dexamethasone.
      a. 10 mg/100 lb. body weight intramuscularly or intravenously.
      b. once, possibly repeated at 8-12 hours.