NMC 2011 Mycoplasma Short Course Handouts
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Introduction

Mycoplasma are the simplest form of self-replicating organisms. They lack the typical bacterial cell wall and attach directly to the host cell to obtain essential nutrients. Mycoplasma species are capable of causing mastitis, arthritis, reproductive disease, ear infections and respiratory disease in dairy cattle. With respect to dairy cattle mastitis, mycoplasma are highly contagious and can be an economically important cause of milk loss and increased culling in infected cows. Mycoplasma mastitis has been reported in most geographical locations that contain intensive dairy production. The prevalence of mycoplasma in routinely tested bulk tank milk on dairies is usually less than 5%. However, shedding patterns, minimum level of detection and dilution by herd milk in large dairy herds, influence the true detectable prevalence.

What species of mycoplasma are known to cause mastitis?

Mycoplasma species known to commonly cause mastitis in dairy cows are *Mycoplasma bovis*, *M. bovigenitalium*, *M. californicum*, *M. canadense* and *M. alkalenscens*. Of these *M. bovis* is by far the most important cause of mycoplasma mastitis in dairy cattle. *Acholeplasma laidlawii* is also found in bulk tank milk particularly associated with rainy, wet weather conditions but it is generally considered not to be a cause of mastitis. Several other mycoplasmas occasionally cause mastitis.

Where can mycoplasma be found on a dairy?

Chronically infected cows with mycoplasma mastitis are the single most important reservoir of mycoplasma on dairies. Isolation of mycoplasma is restricted to animal samples such as milk, joint fluids, reproductive tract discharges, and swabs from ears and the respiratory tract. There is some indication that mycoplasma may invade the blood stream to cause mastitis, however, this not a significant route of transfer. Mycoplasma have also been isolated from environmental locations and are known to survive for long periods in manure. The significance of these environmental reservoirs of mycoplasma is not currently understood with respect to mastitis.
How does mycoplasma move from infected cow to a non-infected cow?

Most mycoplasma infections can be traced to newly arrived heifers or cows on the dairy. Once placed in the milking herd, the highly contagious mycoplasma readily transfer from infected cows to non-infected cows during the milking process on the milking equipment, common towels used for washing or dry udders or milkers’ hands. Mycoplasma enter the mammary gland through the teat opening prior to infecting the secretory tissues. Mycoplasma is very contagious and spreads readily from one quarter to another quarter in the same cow during the milking process. Cows in any stage of lactation – dry or milking – can become infected.

Transfer is also felt to occur in cows with metritis due to uterine discharges flowing down from the vulva onto the udder and teats. Some outbreaks of mastitis have been associated with respiratory disease or arthritis in calves or cows on the dairy. In many cases of mycoplasma mastitis, the precise source and mode of transfer cannot been determined.

Some herd outbreaks of mycoplasma mastitis have been traced to transfer of mycoplasma from large volume bottles of antibiotic solutions that have become contaminated by multiple entry by infusion cannulas. The infusion equipment and containers become contaminated by repeated intramammary infusion of infected cows.

What kind of mastitis does mycoplasma cause?

Mycoplasma causes both subclinical and clinical forms of mastitis. The classical signs of mastitis due to mycoplasma in a herd are:

- Increased incidence of cases that are resistant to therapy
- Clinical cases that involve multiple quarters at the same time
- Systemic clinical signs such as fever and off feed
- Rapid decline in milk production
- Abnormal milk that is often brown to tan with a flaky sediment in watery or serous fluid. Some milk samples when allowed to settle may appear to have a sandy, granular appearance.
- Subclinical mastitis is characterized by elevated somatic cell counts with normal appearing milk. In either case, these observations are not unique to mycoplasma alone.
- In some instances, the mycoplasma outbreak may be temporally associated with increased cases of arthritis or pneumonia or both.
What are the possible ways to treat a mycoplasma-infected cow?

There are currently no known effective treatments for mycoplasma mastitis.

What herd effects does mycoplasma have?

In dairy herds without preventive and surveillance programs, up to 70% of the cows have been reported to be infected. When this occurs, the economic impact on the herd is tremendous. Outbreaks of this magnitude are most often associated with non-hygienic infusion technique or contaminated intramammary infusion products. In herds with surveillance programs, the prevalence seldom reaches 10% and the economic impact is usually mild.

Mycoplasma mastitis results in many and varied effects. These may include any of the following:

- Production loss due to damaged quarters,
- Infected quarters that fail to produce milk,
- Prolonged milking times,
- Increased treatment costs without success,
- Increased amounts of discarded milk following treatment
- Decreased milk quality due to elevated somatic cell counts. Note that individual cow SCC will rise quickly following infection.

- Increased culling
- And increased risk of antibiotic residues in the bulk tank milk.

It is well to keep in mind that many mycoplasma infected cows continue to produce milk at a normal rate. This milk is not of public health concern, however, it will be of low quality due to the persistently high somatic cell counts. Many dairymen prefer to keep these infected cows when they have developed a plan to prevent the spread of infections to non-infected cows.

What are some indications that mycoplasma is in a dairy herd?

- Presence of mycoplasma in the bulk tank milk. This often occurs prior to any significant rise in the bulk tank SCC.
- Increased bulk tank somatic cell counts similar to other major mastitis pathogens. However, in large herds, many cows may become infected with mycoplasma before it is noted in the herd SCC.
- An increase in clinical cases of mastitis that are resistant to usual treatment practices including dry cow therapy.
Does mycoplasma show up when normal milk culture methods are used?

Isolation of mycoplasma from milk samples requires specially modified culture media. The modification is necessary to restrict the growth of bacteria that grow faster than the mycoplasmas. Four to seven days are necessary for isolation of mycoplasma as additional steps and time are required to determine the species of mycoplasma that is present. Speciation is necessary as some mycoplasma that are found in milk are not pathogenic such as *Acholeplasma laidlawii*.

As with any isolation procedure, there is a minimum level of detection. Indeed, dilution of mycoplasma milk from infected cows in the bulk tank milk can occur. However, it has been reported that usual mycoplasma culture methods can detect a single cow in the bulk tank milk from a herd of several hundred milking cows. In some cases, the infected cows are marketed from the herd before the results of the bulk tank milk cultures are completed. Subsequently isolation attempts will result in no more mycoplasmas isolations. Furthermore, infected cows shed mycoplasma intermittently and can sometimes be missed on culture.

Freezing individual cow milk samples will not affect the ability of culture methods to isolate mycoplasma.

What should I do if mycoplasma is found in my dairy herd?

As with any infectious mastitis pathogen, the initial step should be to estimate the prevalence of infection within the herd by culture. Random cow or high SCC cow milk samples may be used. Once the prevalence has been estimated, the economic impact of the infections can be established. The dairymen must decide what the impact will be for any particular herd based on their own risk assessment.

In low economic impact situations such as finding an infected fresh cow or isolating mycoplasma from the bulk tank without any increase in SCC, control actions may be limited to:

- Culling a few infected cows with high somatic cell counts
- Culling a few infected cows that are non-responsive to treatment efforts
- Beginning a mycoplasma prevention and surveillance program
- Evaluation of the milking technique
- Monitoring the herd bulk tank milk for mycoplasma on at least a monthly basis.
- Monitoring the bulk tank milk somatic cell count on at least a monthly basis.
- Culturing all clinical mastitis cases as they occur. Samples may be frozen for later analysis.
- Culturing all herd additions shortly after arrival. Newly arrived or purchased animals should be segregated and milked last until the culture results are known.
- Culturing all fresh heifers and cows within 2-3 days after calving.
• Culturing cows with SCC over 250,000 or linear score greater than 4.0.

In high economic impact situations such as herd outbreaks with many milking cows infected along with elevated bulk tank SCC, control actions may include:

• Culture of the entire herd in an attempt to identify all infected cows.
• Segregation of culture-positive, mycoplasma-infected cows as a separate group. Mycoplasma-infected cows will always stay in this group.
• Establish a milking order so all infected cows are milked last or with separate equipment.
• Intensive culling of infected cows.
• Review mammary infusion practices to insure proper technique.
• Use only sterile, commercially available infusion products for intramammary treatments.
• Begin a monitoring and surveillance program.

What preventive measure can be taken to prevent a mycoplasma serious outbreak?

Begin a surveillance program for mycoplasma by setting up a milk culturing system to include:

• All new herd additions,
• Any cows returning from shows or exhibitions
• All fresh heifers and cows
• All clinical cases of mastitis
• Monthly or more frequent bulk tank milk

By culturing milk in this manner, any new mycoplasma entering into the herd will be detecting quickly before a serious herd problem can occur. Keep in mind that all new herd additions or any animals that have been off the dairy should be considered infected with mycoplasma until proven otherwise by SCC and culture.

Teat dipping and dry cow therapy will have no effect on the incidence of mycoplasma. However, both practices should be continued to prevent and control other contagious mastitis pathogens.
Mycoplasma mastitis is a growing challenge on dairies across the U.S.

By Maureen Hanson

Editor’s note: First of two parts on Mycoplasma mastitis.

Mycoplasma mastitis is It’s everyone’s problem

It once was considered strictly a “California” disease that only affected very large herds. Now it’s on the rise throughout the country, and may soon be knocking on your own door, if it hasn’t already. What is this “new” disease challenge that actually has been around for decades? Mycoplasma mastitis.

Veterinarians who have dealt with Mycoplasma first-hand can attest to the dread that accompanies its clinical emergence. One of them who has more than three decades of experience with it is Paul Blackmer, DVM, owner of Veterinarian’s Outlet, Chino, Calif.

“Mycoplasma mastitis is a doubly insulting disease,” says Blackmer. “Not only can it be remarkably contagious when it is present, but it absolutely does not respond to antibiotic therapy. In fact, treatment can actually cause epidemics, because it frequently is spread by unsound intramammary therapy practices. It’s a problem that dairy producers must manage their way out of, because they can’t treat their way out.”

Client education required
Blackmer believes that helping clients understand the serious nature of Mycoplasma mastitis is a fundamental obligation of all practicing dairy veterinarians. “Preventing Mycoplasma outbreaks requires consistent adherence to specific management steps, on the part of both the owner and the individuals who manage the cows hands-on,” he states. “Everyone must understand the negative consequences that a breakdown in the system could cause.”

Those consequences can include non-responsive, clinical mastitis; a dramatic drop in individual-cow milk production; loss of single quarters that can advance to complete cessation of lactation; and — worst of all — rampant spread of clinical mastitis from cow to cow.
What’s more, the mammary system isn’t the only area that can be affected by *Mycoplasma*, according to Mark Wustenberg, DVM, Technical Services Specialist, Monsanto Dairy, Bay City, Ore. A former practicing veterinarian who focused heavily on milk quality, Wustenberg says respiratory disease and/or arthritis also can plague *Mycoplasma*-infected animals – usually heifers.

The outlook becomes even grimmer when the effect of the disease on calves is weighed. “Calves that are fed *Mycoplasma*-infected milk can contract inner ear and respiratory infections, swollen joints and generalized septicemia that may become active as clinical mastitis upon freshening in first-calf heifers,” says Wustenberg. (See Case Study 3 on page 46 of this issue).

Just how bad can it get? Within the past year, Blackmer has seen more than one dairy lose over 100 cows to clinical *Mycoplasma* mastitis in less than a month’s time. “Make no mistake,” says Blackmer, “this disease is a very real

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**Mycoplasma outbreak examples**

The circumstances that lead to a *Mycoplasma* mastitis outbreak vary greatly. Following are recent examples of cases observed by Mark Wustenberg, DVM:

- A herd that switched from teat dipping to teat spraying, resulting in poor coverage of the teats with disinfectant.
- An expansion herd that was having difficulty getting new animals to use the parlor. The milkers shifted their efforts from good udder hygiene to moving cows — which already were affected by commingling and stress — through the parlor.
- A herd that started using a new teat dip that was difficult to see on the teats, at about the same time that a new batch of heifers was brought in. Teat dipping was sometimes skipped because of the problem with dip color.
- A herd that was diluting medication with hypertonic saline and then infusing it intramammarily.

Continued on page 6
threat to the economic and biological stability of a dairy.”

**Changing landscape fuels spread**
When *Mycoplasma* mastitis was first identified and diagnosed in the 1960s, clinical cases were confined mostly to the then large-herd dairy states like California and Florida. Blackmer attributes this to the owner-milks-cows versus labor-milks-cows phenomenon. “When herds in most of the country were small enough that the owner did most of the milking, *Mycoplasma* was kept well in check, because owners tended to identify and deal with problem cows quickly,” he explains. “In larger herds, where employees do the milking and parlor through-put is a major priority, clinical cases can go undetected longer, and breakdowns in standard milking procedures are more likely to happen.”

Allan Britten, DVM, MS, owner of Udder Health Systems, Inc., Bellingham, Wash., says recent consolidation and expansion of herds across the country have created conditions that are ripe for *Mycoplasma* outbreaks. He and the other experts offer these explanations why:

- **Animal stress.** *Mycoplasma* bacteria — particularly *M. bovis* — are endemic to the bovine respiratory and reproductive tract of many outwardly healthy cows and calves. Clinical experience has shown that *Mycoplasma* outbreaks occur most frequently during times of stress, such as calving, extreme weather shifts and periods of commingling with new animals.

- **Animal movement.** *Mycoplasma* often is introduced when replacement animals — particularly heifers — are commingled into a herd. Heifers are frequent carriers because they often are raised away from the dairy in “high-traffic” facilities and commingled with other animals, then shipped to the dairy for freshening. If heifers were fed *Mycoplasma*-infected milk, there also is the chance that they will harbor systemic *Mycoplasma* infections that break at calving. “Today there’s almost no such thing as a ‘closed herd,’” says Britten, adding that breeding bulls are another potential source of herd contamination.

- **Milking practices.** The principles of good milking hygiene are fundamental to preventing the spread of *Mycoplasma* from cow-to-cow once a clinical outbreak occurs.

- **Infected animals are** the single most important reservoir of *Mycoplasma* species that cause mastitis.

- **Milky mastitis** has been shown to unfold, via research and clinical impressions. Following is a summary of what is currently known about the bugs and the infections they cause.

- **Mycoplasma mastitis** was first reported in the United States in New York in 1962. Much of the early research on the disease was performed by D.E. Jasper at Cornell University.

- **There are at least** nine strains of *Mycoplasma* that have been isolated from milk. Not all are pathogenic for mastitis:
  - *Mycoplasma alkalessens*
  - *Mycoplasma agrini*
  - *Mycoplasma bovigenitalium*
  - *Mycoplasma bovirhinis*
  - *Mycoplasma bovis* (responsible for 50% or more of *Mycoplasma* mastitis infections)
  - *Mycoplasma californicum*
  - *Mycoplasma canadense*
  - *Mycoplasma capricolum*
  - Untypeable *Mycoplasma*

- **Mycoplasma organisms** have no protective cell walls and minimal genetic material. They are resistant to antibiotics in clinically infected cows. It appears that the organisms are capable of rapidly changing their surface proteins. An animal’s immune system targets disease-causing bacteria for destruction by locking onto the shape and size of the bacteria’s surface structures. In the case of *Mycoplasma*, these structures keep changing, the immune system is confused and the organisms escape.
Once established in the milking herd, infections are most often spread during milking or mastitis cannula infusion. Intermittent shedding by asymptomatic carriers may interfere with the accuracy of screening milk from incoming animals. Cows of all ages and at any stage of lactation are susceptible to Mycoplasma mastitis infections. However, cows in early lactation seem to suffer more frequently and severely because the infection may be enhanced by existing inflammatory processes in fresh-cow udders. Clinical signs include:

- Sudden onset of edematous swelling of the udder.
- Severe clinical mastitis that resists treatment, but produces little other effect on the cow. Affected animals continue to eat and drink normally, although the udder tissue may be painful.
- Involvement of more than one quarter and up to all four.
- A marked drop in milk production and increase in individual SCC.
- Abnormal udder secretions that may vary from watery milk with a few clots to a thick, purulent material in advanced cases. Acutely infected cows may show a tanish secretion with sandy or flaky sediments that resemble cooked cereal in a whey-like fluid. Udder secretions may become purulent and last for several weeks.
- Swollen, meaty udders that do not involute properly during milking.

In most cases, infections become established via invasion of the mammary system through the teat orifice. The exception to this may be systemically infected heifers that were infected as calves.

From 10 to 50% of cows may return to a high level of milk production after surviving clinical Mycoplasma mastitis during a previous lactation but may continue to be intermittent shedders of Mycoplasma organisms in their milk for the rest of their productive lives.

Lameness due to an arthritis caused by the presence of Mycoplasma in the hocks and fetlocks of mastitic and non-mastitic cows is frequently seen in infected herds. Arthritic involvement indicates probable long-term presence of the bacteria in the animal.

The organism is very sensitive to the pH changes in milk. Best recovery rates are achieved when fresh milk samples are delivered to the lab and plated soon after collection. However, samples also can be refrigerated for up to three days, and freezing milk samples does not interfere appreciably with the ability to culture Mycoplasma.

It appears that any germicide that effectively controls Staph. aureus will control Mycoplasma. Because iodine disinfectants and sanitizers appear to be the most effective against both Staph. aureus and Mycoplasma organisms, it is recommended that iodine be the sanitizer of choice in a Mycoplasma outbreak.

Sources:
- Kirk, J.N., Mycoplasma Mastitis: Overview, University of California-Davis, Veterinary Medicine Extension Service, Veterinary Medicine Teaching and Research Center publication, Tulare, Calif.
- Rosenbusch, R.F., U.S.-Israeli Scientists Target Cattle and Sheep Diseases, Iowa State University Office of Biotechnology publication, Ames, Iowa.
These factors explain why more Mycoplasma cases are creeping into other parts of the country. In Wisconsin alone, the incidence of clinical Mycoplasma mastitis outbreaks has climbed from just two herds in 1992 to 83 herds in 2000, with a total of approximately 319 herd outbreaks during that time span (see Figure 1). Similarly, herds in the Pacific Northwest (mostly in Washington) have been experiencing a noticeable increase in the presence of Mycoplasma from just 18 positive herds in 1993 to 126 in 2000 (see Figure 2). “It’s not that we just started screening for Mycoplasma and began to find it,” says Britten. “We’ve been looking for it consistently, and we’re truly seeing more of it.”

“Usually, when a Mycoplasma outbreak occurs, it’s because something has broken in the regular routine,” says Wustenberg. “It takes a while for start-up and expansion dairies to establish routines, which is how Mycoplasma flares up.”

Eliminating one unsound management practice, however, can protect dairies from taking unnecessary risks with the disease. “Infusing anything into the udder from a bottle is almost a guaranteed method of spreading Mycoplasma,” says Wustenberg. “Once a bottle is contaminated, it becomes the perfect reservoir for the organism to proliferate. Injecting home brews, saline or anything else from a bottle into the udder is a recipe for disaster.”

Blackmer adds that a misguided treatment practice is infusing dexamethasone along with intramammary antibiotic therapy to reduce udder-tissue swelling. “One complaint we hear frequently about undiagnosed, clinical Mycoplasma cases is that the udder seems full but the milk won’t come out,” he explains. “That’s because it is the blood vessels and supporting structures in the parenchyma — not the milk-storing alveoli — that become inflamed in Mycoplasma infections. The short-term result of this treatment is that the swelling goes down, but accompanying antibiotic therapy is completely ineffective, and the course of the disease remains unchanged. In the meantime, the bottle of dexamethasone often is contaminated with Mycoplasma. It is an ill-advised and completely irresponsible practice.”

(See Case Study 2 on page 46.)

Next issue: Mycoplasma diagnosis, prevention and control.
Mycoplasma mastitis: Prevention and control

Editor’s note: Second in a two-part series on Mycoplasma mastitis.

Accurate diagnostics are a critical element in detecting and diagnosing Mycoplasma mastitis. Before you can effectively help clients prevent and control the disease, you need to be confident that Mycoplasma is, indeed, the organism with which you are dealing.

Mark Wustenberg, DVM, Monsanto Dairy, Bay City, Ore., and Paul Blackmer, DVM, Veterinarian’s Outlet, Chino, Calif., emphasize the importance of sampling clinical cows and culturing them on both blood agar and Mycoplasma agar. As Mycoplasma becomes a larger concern across the country, Wustenberg recommends that practitioners check out the diagnostic labs they are using, to make sure they can accurately perform cultures for Mycoplasma and get consistent results.

“Visit the lab personally, and make sure they do a high volume of milk samples on a regular basis,” says Wustenberg. “They should be able to show you their techniques, and particularly demonstrate their quality control measures. Finally, you should ask to see some examples of Mycoplasma-positive cultures and verify that the lab routinely cultures for Mycoplasma in milk samples, not just swine and poultry.”

Blackmer notes that there is a misconception in some regions that Mycoplasma is hard to grow in the lab. It isn’t. He believes the misinformation stems from labs using an inappropriate media in the early days of Mycoplasma screening.

Many labs read Mycoplasma results at three and seven days of growth, so this timeframe must be factored into the decision-making process in outbreak management. If Mycoplasma

What’s a practitioner to do?

Following are basic, recommended measures by Paul Blackmer, DVM, which every dairy veterinarian can follow to help all dairy clients protect their herds from Mycoplasma mastitis:

- Culture every clinical quarter of every clinical cow on both blood agar and Mycoplasma media.
- Routinely screen bulk tank samples for Mycoplasma.
- Sample and culture every fresh heifer and purchased animal.
- Educate milkers on hygienic milking and mastitis-tube infusion practices.
- Prohibit all use of bottle-sourced intramammary infusions.

For a primer on aseptic milk sampling procedures, visit Blackmer’s website at www.vetoutletonline.com.
Inadequate teat dipping, milking dirty cows and poor claw sanitizing can help spread Mycoplasma.

growth is detected in a new herd with no Mycoplasma mastitis history, Wustenberg also recommends the additional step of validating the sample to confirm that it is Mycoplasma and speciating the organism to determine which strain is involved.

Today, some labs offer enrichment — preincubating milk samples in a broth to enhance Mycoplasma growth, then plating samples from there — to provide extra insurance that Mycoplasma is detected. Although this procedure was developed to better detect and control a dangerous organism, Blackmer strongly believes that it actually clouds the diagnostic picture.

“The more we learn about Mycoplasma, the more we know that the organism is everywhere in the dairy cow’s environment,” he explains. “The chances of pulling a few Mycoplasma bugs from the air into a milking system are great, even with impeccable sampling techniques. So enrichment will allow them to grow, creating false-positive results and diagnostic overreacting.”

Unlike Blackmer, Wustenberg sees value in enriching bulk-tank samples. “We did extensive work on paired cultures to compare the results of enriched and non-enriched bulk-tank milk and found multiple instances where we detected low levels of positive cows after enrichment,” he notes. “The false-positives at the bulk-tank level we found were few, if any. The trick is to recognize that there is the potential for false-positives, and develop a strategy to confirm before panicking.”

But Udder Health Systems, Inc., Bellingham, Wash., owned by Allan Britten, DVM, MS, processes thousands of Mycoplasma diagnostic samples from across the country each year, with no enrichment ever used. “I have not seen any proof that enrichment yields a significant number of additional, true positive samples that would provide better control of the disease,” says Britten. “It adds time and expense to the diagnostic process and is not the most important variable in the management of Mycoplasma mastitis.”

Blackmer’s advice instead: “Do direct plating of all milk samples onto Mycoplasma agar. If you have an intramammary infection, it will show up loud and clear.”

Prevention strategies
The highly contagious nature of Mycoplasma makes biosecurity an essential element in keeping the disease in check.

Four groups of animals are at an exceptionally high risk of either contracting Mycoplasma mastitis or spreading it within the herd:

1. Incoming first-calf heifers

**Bovine Veterinarian/October 2001** 13
2. Other newly acquired animals
3. Fresh cows
4. Sick cows entering or leaving the hospital for any reason

There are a number of practical measures that the experts recommend to prevent *Mycoplasma* mastitis from entering and spreading in a herd:

- **Dedicating separate, sanitary facilities for maternity and sick cows** — versus mixing them together or leaving them with the main herd — will help cut down on the amount of cross-contamination when a clinical case occurs. Ideally, the hospital area should have its own milking facility for fresh and sick cows. If this is not practical, fresh cows and the hospital string should be milked separately from the rest of the herd, with thorough sanitation of the milking clusters after they are milked.

- **Culturing every cow as she leaves the hospital** will help identify new infections that may have occurred in the hospital, and keep a potential outbreak in check.

- **Quarantining incoming groups of heifers or individual animals** and culturing composite, four-quarter samples before releasing them, will help prevent newcomers from seeding the rest of the herd with *Mycoplasma*.

- **Regularly sampling the bulk tank and culturing for Mycoplasma**. Britten suggests that bulk-tank samples be taken and cultured as frequently as once a week in herds larger than 1,000 cows and those with a history of *Mycoplasma* mastitis. Sampling monthly or every other week may be appropriate for smaller herds with no previous *Mycoplasma* episodes.

- **Scrupulous udder hygiene** — including thorough pre- and post-dipping of teats, using individual cloth towels and maintaining excellent teat-end condition — also will prevent the spread of *Mycoplasma*.

- **Good teat cannula management** also cannot be overemphasized. “Poor treatment hygiene can turn an isolated clinical *Mycoplasma* case into a massive outbreak virtually overnight,” says Blackmer. “Even having more than one treatment cannula exposed in the hospital or parlor is risky, given the very high likelihood that it could be seeded with *Mycoplasma* from the air, flies, fingers, swishing tails, splattering urine or uterine discharge before it enters the teat orifice.”

- **Culturing every clinical quarter of every cow with clinical mastitis** will help producers pinpoint *Mycoplasma*.

Clinical *Mycoplasma* mastitis often produces severely altered mammary secretions that appear tannish in color with hard, gritty clots.
cases and deal with them knowledgeably. Wustenberg also suggests monitoring individual-cow SCCs and culturing cows that convert from an SCC below 200,000 to above 200,000 in a one-month period.

**Culturing composite milk samples from all fresh heifers** (and also fresh cows if the herd has a history of Mycoplasma mastitis) also is advised. The subject of backflush units also stirs some debate among the veterinarians. “Backflush units can easily create a false sense of security that causes a dairy to cut corners on the other fundamental practices that are important for effective Mycoplasma control,” states Blackmer. “They also tend to use an excessive amount of water and chemicals, and often the valves don’t stay clean. They can cause deteriorating milk quality, and their external surfaces remain fomites.”

But Wustenberg and Britten aren’t so quick to cancel out the technology. Wustenberg likens backflush to a rider on an insurance policy. “You can buy different levels of insurance, and some dairymen are more risk-averse than others,” he says. “Backflush does not replace good, basic management practices, but, when used and maintained appropriately, it can be part of the solution.”

Britten adds that, like virtually any technology, backflush can be useful but only when it’s used appropriately. “It certainly doesn’t make any sense to put a dirty machine on a healthy cow,” he says, “but if backflush is going to be used for protection, it has to be functioning effectively and safely. It is an important role for the veterinarian to provide counsel to clients and communicate with equipment dealers and technicians. The practitioner should be regularly evaluating the system for alignment, leakage and germicide coverage and pointing things out that need improvement.”

**Outbreak offense**

When a routine bulk-tank culture shows positive for Mycoplasma, the best-case scenario is that it amounts to no more than a single, culprit cow being identi-
Mycoplasma

Continued from page 16

fied and culled. A positive tank alone does not automatically spell disaster, Wustenberg points out, because in this scenario the problem can be identified and eradicated very swiftly.

Detecting the perpetrator(s) may require various levels of investigation:

- In some cases, a new heifer or clinical cow immediately sticks out and is found, confirmed and culled. Such animals will be even more obvious on dairies where routine cultures are performed on every cow undergoing intramammary therapy.

- The next level of investigation is string sampling: culturing composite samples from milking strings and then performing individual-cow cultures only on the animals in the positive string(s).

- In cases with heavy bulk-tank Mycoplasma loads (heavy growth) and/or a herd history of Mycoplasma mastitis, whole-herd culturing to detect the positive cow(s) may be warranted.

The other way that Mycoplasma typically surfaces in a herd is a high incidence of nonresponsive mastitis cows in the hospital. Wustenberg says that in those cases, the bulk tank may never even go positive, because clinical mastitis milk is withheld from the tank, and the Mycoplasma-positive cows are either culled or identified via culturing of clinical quarters. Or, the incidence of infected cows is low enough that it dilutes out in the bulk tank.

What to do with Mycoplasma-positive cows is another issue of some debate in the industry. If the problem stems from one or two cows, culling is deemed the most appropriate measure. Likewise, no one believes that chronic clinical cows should be kept around.

But in the case of larger-scale outbreaks, “wholesale culling may be an extravagance that some dairies cannot afford,” says Blackmer. This is particularly true in expansion situations, when the dairy is under pressure to maintain cow numbers for collateral.

One diagnostic concern is the cow that cultures Mycoplasma-positive but exhibits no clinical signs. Given the high number of colony forming units (CFUs) in a true clinical case, sample contamination can be a common problem. Blackmer describes a “trailer effect” that poor sampling technique can produce: “In three samples taken in a row, the first cow may be clinical and show obvious, confluent growth. The next one may show moderate growth, and the third one a trace of Mycoplasma. What probably happened is that the second and third cows were normal, but their samples were contaminated in the collection process.”

Blackmer recommends re-culturating positive animals that appear healthy, to confirm their Mycoplasma status before taking further action. Similarly, Britten suggests physical examination and a CMT test for such animals, with another culture if they are CMT-negative. Most important, both practitioners emphasize the importance of carefully training the individuals taking the samples to reduce the incidence of contamination errors.

The other animals that present a quandary are known Mycoplasma cows that resolve the infection and remain productive. Rather than immediately culling these cows, Blackmer sometimes suggests permanently identifying and moving them into a segregated, “to-be-culled/do-not-breed/junk” string, along with cows that are confirmed positive but show no clinical signs. The main herd is then clean and pathogen-free, and the Mycoplasma cows can be milked until the end of their productivity, which may be years later.

Mycoplasma bacteria in pasteurized milk pose no known human health risk. Blackmer says cows that have survived one episode of Mycoplasma mastitis often endure and resolve subsequent flare-ups. No antibiotic or supportive therapy is needed, but if the clinical state becomes chronic or their productivity drops to a point of negative profitability, they should be culled.

This approach to temporarily salvaging Mycoplasma-positive animals may sound easy. It’s not. Blackmer cautions that the individuals working with these cows must be thoroughly educated about the highly contagious nature of the disease and trained to protect the rest of the herd from contamination without fail. Steps in that process include:

- Double-identify Mycoplasma-positive cows with leg bands, ear tags, ear notches, etc.
- Milk the junk string at a designated sequence in the dairy’s milking schedule, with thorough sanitation of the milking system — including internal
Although more needs to be learned about the organism, one thing is certain: *Mycoplasma* mastitis is here to stay.

and external surfaces of clusters — after they pass through the parlor.

- Never allow cows from the junk string to enter the hospital, where they could contaminate cows from the clean herd.
- Never feed milk from known *Mycoplasma*-positive cows to calves, even if pasteurization is available. The risk of a breakdown in the process and subsequent infection of the calves is too great.

The decision of whether or not to temporarily keep *Mycoplasma*-positive cows on a dairy will vary from case to case and should be based on the dairy’s economic condition; number of animals involved; level of milk production and reproductive status of infected animals; and the availability and price of replacements. Dairy managers also need to seriously consider whether they believe their staff and facilities can accommodate effective isolation and management of *Mycoplasma*-positive cows.

**Hospital hot spot**

In the throes of a severe *Mycoplasma* outbreak, other vigilant management efforts are needed. Clinical cows should be moved away from the rest of the herd to an isolation area. Blackmer prescribes a strict halt to anything going into any cow’s teat end in the hospital — no mastitis tubes, no dilators, nothing.

“I am not a believer in the ‘no intramammary therapy’ approach to clinical mastitis management, but in the case of a *Mycoplasma* outbreak, I make an exception,” says Blackmer. “The value of protecting *Mycoplasma*-negative cows in the hospital outweighs the benefit of treating them for other types of mastitis.”

The practitioner describes some dairies’ hospitals in the middle of an outbreak as “myco city.” The heavy pathogen load that is shed from infected animals can quickly overwhelm the usually small hospital barn, to the point where virtually every exposed surface is contaminated. Blackmer suggests daily foam disinfection of the hospital’s walls and other exposed surfaces to reduce the environmental presence of *Mycoplasma*.

If the hospital has its own milking facilities, he also recommends a thorough cluster-dunking process to disinfect milking units between every hospital cow.

**Learning to live with it**

Although more needs to be learned about the organism, one thing is certain: *Mycoplasma* mastitis is here to stay. Its highly contagious nature, ability to survive in the environment and massive pathogen loads shed from infected animals make it uniquely challenging to control. As it surfaces in new areas of the country, the disease will only add to the managerial mix in today’s changing dairy industry.

“The penalty for error with this disease is pretty high,” says Britten. “It behooves us all as veterinarians to get a good handle on how to manage it before we have to deal with a clinical outbreak.”

Blackmer relates a *Mycoplasma*-education example often used by a former California extension agent. “He would stand in front of a room of veterinarians or dairyman holding up a vial containing no more than 10 mL of milk and say, ‘In this vial I have enough *Mycoplasma* bacteria to infect every cow in California.’

“He was right, but the example may not have completely hit home for the listeners until they dealt personally with a *Mycoplasma* outbreak,” Blackmer says. “Client compliance is much higher if a dairy producer has endured a bout with the disease. Unfortunately, a growing number of producers and veterinarians across the country are receiving crash courses in *Mycoplasma* management. It is not an impossible disease to control, but it’s certainly one that should keep us all on our toes.”

Mycoplasma bovine mastitis is a highly contagious disease that results in milk loss and culling of infected animals. Frequently, this type of mastitis goes unrecognized in dairy herds and is spread in part by the sale of infected cows to unsuspecting buyers.

The disease was first reported in the United States in 1961 in the state of Connecticut (16). Mycoplasmas were subsequently responsible for epizooties of mastitis occurring in dairy herds in New York State. The causative agent, a Mycoplasma serologically identical to the Connecticut strain, was later designated *M. bovis*. Mycoplasma mastitis epizooties also occurred in California in the middle 1960's. Since that time, the disease has been diagnosed in the states of Oregon, Washington, Idaho, Alaska, Florida, Texas, Arizona, Arkansas, Hawaii, Pennsylvania, and more recently in Alabama (25), Wisconsin (33) and Ohio (18). In our laboratory, *M. bovis* has been isolated from herds in Maine, Vermont, New Jersey, Massachusetts, Maryland, Tennessee, Colorado, Michigan, Georgia, New Hampshire, Iowa and Puerto Rico. It seems that we only need to look for mycoplasmas to find them.

**Mycoplasmas and mastitis**

Initially, mycoplasmas were called pleuropneumonia-like-organisms (PPLO) in view of their similarity to the pleuropneumonia agent of cattle. The term PPLO is still used today for commercial media prepared for the isolation of mycoplasmas. The byproducts of growth and metabolism of mycoplasmas irritate the mammary gland tissue resulting in a marked inflammatory response characterized by acute swelling and agalactia. Several species of mycoplasma (*M. bovis, M. californicum, M. canadense, M. bovigenitalium, M. alkalescens, M. arginini, M. bovihirnis, M. dispar*, bovine group 7, and F-38) can cause mastitis in dairy cows (1,24,27). Disease detection at the herd level is usually made by isolation of mycoplasmas from either bulk tank milk or samples from cows with clinical mastitis.

*Mycoplasma bovis* is the most frequent and pathogenic bovine mycoplasma in the United States (15). It has been associated with a variety of bovine diseases such as abortion and low fertility, arthritis, keratoconjunctivitis, mastitis, pneumonia, and synovitis (4,17,23,28,29,31). Diseases caused by mycoplasmas are resistant to antimicrobial therapy although they are susceptible *in vitro* to several antibiotics (3,4). Mastitis caused by *Mycoplasma* may be subclinical, clinical or chronic. The affected cow lacks systemic signs of disease and continues to eat and drink normally.

Mastitis-causing mycoplasmas are commonly found in the mucous membranes of the respiratory and urogenital tracts of healthy cows. However, stresses such as calving, extreme temperature
variations, transportation, disease or external trauma may allow the organisms to enter other body tissues or directly into the mammary gland resulting in clinical mastitis (4,21). Herds with and without mycoplasma mastitis may contain both young and mature asymptomatic carriers (4,21,23). The young are exposed to the various mycoplasmas during calving by direct contact with the urogenital tract, from nasal discharges of the dam, and in milk they receive from shedding animals (4,21). *Mycoplasma* may be shed in nasal discharges of calves and in vaginal discharges of heifers at the time of calving. Thus, it is extremely important to realize that even though a dairy is not currently experiencing mycoplasmal mastitis, the organisms are more than likely present within the herd and the possibility of a mastitis outbreak always exists.

**Clinical signs**

Cows of all ages and at any stage of lactation are susceptible; however, cows in early lactation seem to suffer more severely because of the increased mammary gland edema that occurs (4). In lactating cows the characteristic signs of mycoplasma mastitis are (4,21):

1. An increase in severe clinical mastitis cases that resist treatment, but with little other effect on the cow.
2. The involvement of more than one mammary quarter, sometimes all four.
3. A marked drop in the milk production of affected cows.
4. Abnormal udder secretions that may vary from watery milk with a few clots to a colostrum-like material. Chronically infected cows may show a tannish secretion with sandy or flaky sediments that resembles cooked cereal in a whey-like fluid. Udder secretions may become purulent and last for several weeks.

Cows which continue lactating produce less milk than expected for the current lactation, usually with normal appearance but with high somatic cell counts. They may shed mycoplasma organisms intermittently for variable periods (4,21,23). Infected cows may return to their expected milk production in the same lactation, remain infected in the dry period, and increase their milk production in the following lactation while shedding *M. bovis* (10,12). Some cows may eliminate *M. bovis* mammary gland infections by themselves after the clinical episode, usually during the dry period (10,12). The variable duration of clinical signs and shedder status contributes to the difficulty in predicting the outcome of infected quarters and the determination of complete bacteriologic recovery. For this reason, cows diagnosed positive for *Mycoplasma* should probably be considered positive for life even though this may not be the case (21). The severity and the recovery from the infection may vary within herds and between herds, depending upon the species of *Mycoplasma* as well as the relative susceptibility of the cows. Dry cows are equally susceptible to infection by *Mycoplasma* but show little swelling or other signs until freshening, at which time a full blown clinical case results. Lameness due to an arthritis caused by the presence of *Mycoplasma* in the hocks and fetlocks of mastitic and non-mastitic cows is frequently seen in infected herds (4,11).
Diagnosis

Diagnosis of mycoplasma infection in milk depends primarily upon microbiological culture of udder secretions. Speciation is accomplished by immunofluorescence or an indirect immunoperoxidase test. Although the reliability of the method is satisfactory, it is time-consuming, as 3 to 7 days of incubation may be necessary before plates receive a final reading; speciation can require several more days. Isolation of mycoplasma is usually made on petri plates containing modified Hayflick medium, of which there are several variations (6). Composite milk samples are usually streaked over one-half of a plate and bulk tank milk samples over an entire plate. Plates are examined for colonies under low power on a standard microscope or, more effectively, under a stereomicroscope or dissecting microscope. Growth may be seen after 3 days of incubation at 37 C in a moist 10% CO2 incubator or in a moist candle jar, but 5-7 days of incubation is needed for the full development of colonies. Incubation should proceed 7-10 days before plates are diagnosed as negative.

Large numbers of mycoplasmas are usually present in samples from clinical cases of mastitis, but only a few organisms may exist in samples from chronic or carrier cows (4,21,23). Culture of bulk tank milk is a useful procedure to determine the existence of mycoplasma infected cows in a herd (9,21); however, the method has its limitations (7). In 2 herds in which mycoplasma was isolated from bulk tank milk, Mycoplasma sp was isolated from 1 (0.33%) of 307 milking cows and from 2 (0.36%) of 548 milking cows (7). However, M. bovis was not isolated from the bulk tank milk in herds where 7 of 66 (10.61%) and 6 of 51 (11.76%) cows were infected with the organism (9). This could be attributable to various rates of mycoplasma shedding related to stages of infection in infected udders (7,8), the sensitivity of the bacteriologic procedure used to detect Mycoplasma, or to the fact that dairy farmers withhold abnormal milk from mastitic cows from the tank (9,21,32).

Enhanced growth in broth followed by culture on a mycoplasma agar medium has been suggested (24,35). Thurmond and co-workers (35) found that the combined use of direct inoculation and pre-enrichment yielded 70% more isolates of Mycoplasma from bovine milk, than the direct inoculation on mycoplasma medium plates alone. At our laboratory, the examination of 4,116 milk samples by both direct inoculation of milk on Hayflick agar plates and pre-enrichment in Hayflick broth produced only a 6% increase (13). Therefore, we agreed with Jasper (24) that the use of pre-enrichment did not increase isolation of Mycoplasma significantly, but increased the cost of diagnosis.

Most mycoplasmas isolated from bulk tank milk and cow milk samples are pathogenic but some may be Acholesplasma laidlawii, a common nonpathogenic saprophytic contaminant frequently found in the dairy environment and the teat skin (4,21). Therefore, speciation of Mycoplasma-like colonies is recommended. Digitonin inhibition of sterol metabolism by mycoplasma was reported as a practical and easy method to discriminate between isolates of Mycoplasma and A. laidlawii from milk (36).

All mycoplasmas are very sensitive to pH changes in the milk. Best recovery rates are achieved when fresh milk samples are plated soon after collection and delivery to the laboratory. Samples
may be kept refrigerated for 3 days or frozen for longer periods before culturing on mycoplasma medium.

A herd suspected by a veterinarian of having mycoplasma mastitis, based on history and clinical signs, should be cultured in order to establish the nature of the infection. Mycoplasma infections are frequently complicated by common bacterial infections appearing concurrently.

**Epizootiology**

Most transfer of mycoplasma infection within herds occurs at milking time by means of fomites such as milking machines, teat cups and hands (4,21,23). Many new herd infections occur from the introduction of replacements with infected udders (4,9,21). Treatment of mastitis provides a good opportunity for spread from cow to cow, and even from herd to herd if rigid sanitary precautions are not followed (4,21). However, an outbreak of mycoplasmal mastitis may occur in previously clean herds without introduction of animals or history of previous intramammary treatment (4,9,21).

Since *M. bovis* is widely found as a resident of the bovine respiratory tract of apparently normal cows, transfer from the lungs to the mammary gland by hematogenous or other routes has been postulated (23). Once an udder infection is established, rapid spread within a herd can occur by more routine methods for spreading mastitis. Hematogenous spread of *M. bovis* was demonstrated when the organism was recovered from viable fetuses and calves of cows with mastitis (30). Later, researchers isolated mycoplasma from the blood of calves within a week after intratracheal inoculation (34).

The prepuce and distal urethra were found to be sites of colonization by various mycoplasma and ureaplasma in the genital tract of apparently normal bulls (19,20). This results in infected semen and may be a way of dissemination of these organisms. Use of infected semen has been shown to result in lowered conception rates, increased services per conception and prolonged calving interval (26).

Bennett and Jasper (2) found a high percentage of young calves fed *M. bovis*-infected milk to have respiratory infections (19.8-47.4%). Many of these infections persisted for at least 9 months. Calves from herds without mycoplasma mastitis had low rates of *M. bovis* infection (3.9-8.7%) for up to 5 months. Lateral transmission of respiratory infection between calves occurs (11). It may be airborne (11,20) and persist until the first calving (30). In some small New York herds in which calves, heifers, and cows were kept in the same barn, mastitis cases started within a month after calves were diagnosed as having pneumonia and inflammation of the joints (9,11).

In California, the risk of large herds (>350 cows) having a mycoplasma-positive bulk tank sample was 15 times greater than that of small herds (<350 cows) (32). The reason for this was thought to be a combination of several poorly understood management factors commonly found in larger California herds (32). In contrast, size was not a risk factor in affected New York herds having 30 to 400 milking cows (9).
In New York, the highest frequency of clinical mastitis due to mycoplasma was found to occur during the winter, starting late in the fall, peaking in January, and decreasing by mid-spring (9). A similar seasonal variation of Mycoplasma mastitis was also observed in California and was attributed to improper ventilation in the barns (22).

Quality Milk Promotion Services investigated 140 herds with mycoplasma mastitis problems between January 1989 and December 1995. In almost all the herds, mycoplasmas were introduced when replacements (virgin heifers, pregnant heifers or cows) were purchased and commingled with the existing herd without quarantine and bacteriological testing (14). In the states of New York and Pennsylvania, we have frequently seen that purchased heifers were the origin of severe mycoplasma mastitis in previously mycoplasma free herds, the heifers showing clinical mastitis immediately after calving (9,11).

Lateral transmission of the infection was frequently observed in poorly ventilated barns and airborne transmission among animals of different ages was suspected (9,11). In several farms where calves, heifers and cows shared the same barn, clinical mastitis in lactating cows was associated with exposure to calves, heifers and cows with signs of respiratory disease (11). On other farms, cases of clinical mastitis started after calves were diagnosed as having pneumonia and arthritis (14).

In some areas in New York State where mycoplasma mastitis appears to be endemic and where epizooties occurred between 1976 and 1980, we speculated that the disease could have been transmitted between adjacent farms by people who were in contact with infected milk, such as milkers, herd owners, milk plant truck drivers, and veterinarians (9). Contaminated equipment, treatment devices, clothing, sampling meters or any type of improperly cleaned material could have served as fomite vehicles (4).

Control

There is no treatment for mycoplasma mastitis. Control of the disease relies on identification of infected cows by culture of composite or quarter milk samples from all milking and dry cows in the herd (4,21). All cases of clinical mastitis should also be cultured as well as all animals at freshening, including heifers. *Mycoplasma*-infected cows must be segregated and milked last or with a separate milking unit from those used on uninfected cows to minimize the risk of infection for other cows (12,21). Recently, the first spontaneous and complete recovery from *M. bovis* mastitis was reported (10,12). Cows infected with other mycoplasma may recover and stop shedding during the same lactation (4,21,23). Slaughter of all infected cows is indicated when a few animals in the herd are infected. The exact mode of handling will vary from dairy to dairy based upon the owner's attitude, facilities, number of infected animals, the level of milk production and reproductive status of carrier animals, and the availability of replacements (4,21). The use of rubber or plastic gloves and disinfection of gloved hands between cows is advised when milking or treating cows in a mycoplasma infected herd (4,21,23). Single treatment devices are recommended if treatment for any other type of mastitis is necessary in herds known or suspected to have mycoplasma mastitis.
In large herds, culture of bulk tank milk samples collected after milking each production group may be used as a method to locate groups in which mycoplasma infected cows exist. Then, individual composite milk samples can be used to identify the infected cows in those production groups.

Weekly monitoring of bulk tank milk to detect the presence of mycoplasmas should be encouraged to monitor the success of control procedures. This monitoring should continue until pregnant heifers and all cows that were dry during the mycoplasma mastitis outbreak have calved.

Spread of mycoplasma can be greatly reduced by good milking procedures. Premilking teat disinfection before applying teat cups and postmilking teat dipping should be used. At the Quality Milk Promotion Services, we favor the use of iodine products (0.5 to 1%) during mycoplasma bovine mastitis outbreaks. The use of backflushing for disinfection of milking units between cows has been emphasized (4,32,33). However, the installation of this system is usually expensive, and in our experience has minimal effect in reducing infections. Furthermore, teat dipping should also be used before and after intramammary treatment of nonlactating or lactating cows for organisms different than Mycoplasma.

Great care should be used when purchasing cows and heifers. Milk from all replacements should be cultured for Mycoplasma as well as for Streptococcus agalactiae and Staphylococcus aureus before allowing replacements to commingle with the herd (13,14,21). When herds are purchased, it is a good policy to culture all suspected mastitic cows as well as the bulk tank. All actions should be based upon the understanding of the highly contagious nature, slow recovery rates and the ineffectiveness of treatment of mycoplasma infections (21).

With informed dairy farmers and alert veterinarians, most herd infections can be prevented or diagnosed early (21).

References


Most all dairymen that have been around the block once or twice are aware that Mycoplasma causes a serious form of mastitis. Mycoplasma mastitis is usually seen as clinical mastitis often involving more than one quarter. It is difficult for dairymen to ignore as the clinical cases do not respond to treatment. In herd without monitoring programs, many cows can quickly become infected with marked increase in the bulk tank somatic cell count. Fewer dairymen are aware that Mycoplasma may be involved in several disease conditions such as “pinkeye”, meningitis, ear infections, abscesses, pneumonia, vaginal inflammation, abortions and arthritis. Outbreaks of these conditions maybe associated with Mycoplasma mastitis outbreaks within their herds. The purpose of this article is to review these less known conditions caused by Mycoplasma.

Conjunctivitis and “Pinkeye”

Eye infections caused by Mycoplasma may appear very similar to the “pinkeye” that is often caused by the bacteria Moraxella bovis. Mycoplasma bovaculi is the most common Mycoplasma involved in eye infections, however, it is not commonly associated with mastitis. Mycoplasma bovis, a common bovine mastitis pathogen, has occasionally been reported as being involved with ocular lesions. The signs of the disease may be only weeping or excessive tearing with some reddening of the white portion of the eye. Other times, severe swelling and ulceration of the cornea may occur. When Mycoplasmas are involved in conjunction with bacteria, treatment response is often poor compared to bacteria “pinkeye”.

Meningitis

Occasionally, outbreaks of brain infections have been reported in young calves. The clinical signs are usually rather non-specific and give no definite suggestion that Mycoplasma may be involved. The signs are lethargy, off feed and lying down a lot more than normal. Calves may also show fever, abnormal eye movements, extension of the head, convulsions, be hypersensitive to touch or sound and appear to have neck pain. Mycoplasma bovis is the Mycoplasma that has been isolated in some instances. Clinical signs are usually severe, respond to treatment is poor and mortality in these cases is usually high.

Ear Infections
Mycoplasma bovis has been isolated from some young calves with ear infections. These calves showed drooped ears and head tilt along with excessive tearing and recumbency. Mycoplasma has been isolated from the exudates from the inner ears from some of these calves. In some cases, many calves may be affected.

**Abscesses**

Mycoplasma bovis was felt to be the cause of superficial abscesses found on the brisket, knees and stifles of young calves in hutches. The abscesses were found on the surfaces where pressure and skin abrasion commonly occur. The investigators thought that the Mycoplasma gained entry through the injured skin or that the organisms had localized in these areas following entry through another site.

**Pneumonia**

Mycoplasma dispar, usually not associated with mastitis, and Mycoplasma bovis have been isolated from calves with respiratory disease. With Mycoplasma alone, the respiratory signs are often unnoticed or very mild. Usually the cases are predisposed by environmental stress particularly in housed calves with poor ventilation; the presence of other respiratory pathogens; and immunosuppression. It is often felt that for Mycoplasma to cause pneumonia, other more virulent pathogens must be present in the lungs. For this reason, it is not uncommon to isolate bacteria or viruses along with mycoplasmas from calves with pneumonia.

**Vaginal Inflammation**

Several mycoplasmas species have been isolated from both normal and infected reproductive tract of cows. The effect of mycoplasmas on fertility is questionable as reports in the scientific literature have been both positive and negative. Mycoplasma bovigenitalium, a mastitis pathogen, has been frequently isolated from cows with vulvovaginitis. This organism also causes mastitis and the source may be from infected vaginal discharges running down onto the udder and teats. In these infected cows, the lining of the vagina may have raised granules or papules and an abnormal, cloudy to purulent discharge may be present. The infections usually last about 3-10 days and then spontaneously disappear. These same mycoplasmas can also be isolated from bull semen and may cause infections in the reproductive organs of bulls. In bulls and cows the mycoplasmas may be only intermittently shed thus complicating diagnosis by isolation. When outbreaks of vulvovaginitis occur, veterinarians often recommend suspending natural bull breeding and using double-sheathed AI instruments. Many times culling of infected animals is suggested.

**Abortions**

Both Mycoplasma bovis and Mycoplasma bovigenitalium have been associated with bovine abortion. It is thought that they cause abortions by infecting the placenta or by causing fetal pneumonia. Thus to establish a diagnosis of abortion due to Mycoplasma
the diagnosticians usually have to find either placental infection or fetal pneumonia along with the isolation of Mycoplasma. Finding these lesions is necessary as Mycoplasma is often found throughout the reproductive tract. In one study, Mycoplasma bovigenitalium was isolated from 12% of normal appearing reproductive tracts.

Arthritis

Arthritis in a single joint or polyarthritis in many joints is another syndrome that may be caused by Mycoplasma. The lesions may be confined to a single joint or involve multiple joints with damage to the joint surfaces and cartilage. Calves and cows may show stiffness, shifting leg lameness, difficulty in getting up or non-weight bearing lameness. The affected joints are usually hot, painful and swollen. The animals themselves may have fever, go off feed and loose weight when multiple joints are involved. Attempts at treatment give variable results and are often unrewarding.

Control Measures

The possible control measures for Mycoplasma are the same as those for most infectious diseases. New arrivals should be quarantined for at least 30 days. Early identification of cows with Mycoplasma mastitis and other conditions may help to control outbreaks. Minimize contact of known infected animals with other animals in the herd. This is particular important to prevent spread from infected cows to calves. Hospital milk should not be fed to young calves. Pasteurization effectively destroys these organisms and should be used when waste milk is fed to calves. Cows with pneumonia should be isolated from other cows. Cows with multiple joint lamenesses should be marketed quickly as they can be anticipated to have poor response to therapy. The use of preventive vaccinations may be warranted to minimize the ability of other diseases to collaborate with Mycoplasma to cause severe clinical disease.

Summary

Mycoplasma organisms can be isolated from normal and sick cows. Mycoplasma can cause or be contributory in many disease situations seen on dairies such as pinkeye, ear infections, meningitis, abscesses, pneumonia, vaginal infections, abortions, and arthritis along with mastitis. Many times several of these conditions occur at the same time on a dairy. As an example, calves may be having pneumonia and arthritis while the milking cows are going through an outbreak of mastitis. Cows with Mycoplasma mastitis may also have arthritis. The Mycoplasma organisms have the ability to move in the blood stream, to result from trauma and to extend from one infected area to a nearby area. During outbreaks of pneumonia, infected animals may spread the Mycoplasma by aerosol and droplets that may contaminate feed and water. In many instances, Mycoplasma acting alone will only cause mild infections, however, when coupled with other bacteria or viruses, severe conditions can result. The exception to this is mastitis where Mycoplasma alone is sufficient to cause severe disease. Often therapy is not successful for any of the Mycoplasma diseases. Your veterinarian can assist you in taking the proper samples to
get a definitive diagnosis and setting up a plan for controlling Mycoplasma within your dairy herd.