Managing Mastitis 1

Streptococcus uberis

Over the past years Streptococcus uberis has become one of the top three pathogens in dairy. In housed cattle, infection rates are highest in the first 75 days of lactation.

Up to 60% of cases stem from new infections picked up at drying off or in the two weeks before calving.

Streptococcus uberis can also account for a large portion of the clinical cases at grass especially in hot weather when cows camp under shade trees and are more likely to pick up the pathogen from faecal contamination of the pasture.

While considered an environmental pathogen, persistent infection with Streptococcus uberis meanwhile make up to 20% of all cases.

Obviously some strains have become 'cow adapted' making them responsible for the contagious spread of the organism from cow to cow at milking time and for raising bactoscans in the bulk milk sample.

Although Streptococcus uberis are sensitive to penicillins, effective treatment is not easy to achieve. For the antibiotic to work the bacteria need to be actively dividing.

This organism, however, can go through phases of slow multiplication and even dormancy which can make the standard tube treatment ineffective.

Streptococcus uberis can also invade the epithelial cells in the udder and can sometimes persist without affecting the cow and this makes the bacteria more difficult to eradicate. In order to tackle Streptococcus uberis effectively the following strategy has been shown to work:

- Improve hygiene in cow accommodation. Keep bedding clean and dry.
- Prevent grazing on contaminated pasture in hot weather and change calving paddocks regularly.
- Pay attention to milking routine – gloves, pre-dipping or using medicated teat wipes are all effective tools to ensure hygienic conditions.
- Ensure your milking machine is working efficiently (when was your last test?) and change liners every 2500 cow milkings. (Have you worked it out – how many units have you got and how many cows do you milk?)
- Treat clinical cases promptly. Particularly when seeing recurring cases, consider systemic treatment.

Most often, cell counts in unaffected quarters will also rise. Here, for example, penethamate has been shown to build up in highly efficacious concentrations in the udder leading to cure even in difficult to treat cases, while also significantly reducing cell counts in total, including unaffected quarters.

- Consider using a teat seal backed up with intramammary antibiotics to control infections in the dry period.
- Know your enemy – milk sample problem cows to isolate the pathogen and carry out post treatment sampling to monitor cure rates. ■

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Treatment during lactation?

On farm, antibiotics are routinely used for the treatment of clinical mastitis during lactation and for high somatic cell count (SCC) cows at dry-off. Treatment of persistently high SCC cows, however, during lactation is rather the exception than the rule although antibiotics specifically registered for treating high SCC cows during lactation are available in most European countries either as an intramammary (pirlimycin) or as a systemic treatment (penethamate hydriodide).

The reasons for not treating high SCC cows with antibiotics are superimposed by perception and expectation: a treatment effect is not obvious, before and after treatment the cow seems healthy and the milk appears normal. In addition, many consultants advise against treating high SCC cows during lactation as not effective and therefore not economic, an attitude not sustained by a lot of scientific evidence.

It is certainly correct to argue that curing persistently high SCC cows does not improve milk production. At this point however, the indirect effects and benefits of cure are overlooked:

- Prevention of flare ups of clinical mastitis; studies following high SCC cows for nearly two years have clearly shown that in time these cows have repeated clinical flare ups. As a result of treatment, cure of high SCC cows is likely to prevent clinical mastitis in the same cow as well.
- Prevention of transmission of the infection to other herd mates. Streptococcus uberis and Staphylococcus aureus are the most important bacteria causing a persistently high SCC in cows.

Both bacteria can easily be transmitted to other cows in the milking parlour. Thus, curing such high SCC cows will also prevent the transmission to other cows in the herd.

If these indirect effects of treatment, prevention of clinical mastitis and prevention of transmission are taken into account, treatment might well be worthwhile and rewarding.

This was proven to be true in recent economic modelling studies. However, the economic efficacy is dependant on a number of factors which would have to be assessed first in order to determine the treatment success such as cow factors (the age, SCC, lactation stage and quarter location), the probability of transmission on a farm, the bacterial strain and the duration of treatment.

For example, treating a penicillin sensitive Staphylococcus aureus infected heifer with a SCC lower than one million cells/ml late in lactation in a front quarter for three days is economically profitable, whilst treatment of a cow of third and higher parity infected with the same strain but at a SCC level of one million cells/ml and more in a front quarter for three days in mid lactation will not be economically reasonable. This shows that economic efficacy can only be reached by selecting the right cow for which treatment is justified and the right treatment duration.

Certainly, the outcome of such a treatment schedule is not independent of general economic factors such as milk prices and the presence or absence of milk quotas.

A practical approach on every farm is shown below.

With the continued strive for higher milk quality on one side and the need to scrutinise the input level on the other side, these recent findings will probably change the views on treatment of high SCC cows during lactation. A more targeted treatment of the right cow can make treatment success more predictable, lead to a higher probability of cure and therefore, can be economically rewarding.

This way, treatment of cows with high SCC during lactation one day will move from an exception to an integral part of the dairy farm management protocol. ■

% of new infections/year

>10%

Priorities
1. Optimise udder health management
2. Treat high SCC cows with antibiotics

<10%

Priorities
1. Udder health management is okay
2. Do not treat in general, but select cows for treatment

Cow criteria that increase cure:
1. Young cows (parity 1 or 2)
2. Infection in front quarter
3. SCC <1 million
4. Days in milk >200 days

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Applying diagnostic tools

Mastitis continues to be a disease of greatest economical impact in dairy herds mandating conscious decisions to minimise losses and costs associated with it. As a first step, mastitis has to be detected preferably at an early stage. Early diagnosis is crucial because it allows for a timely treatment resulting in higher likelihood of cure.

Ideally, mastitis detection techniques have to be reliable, cheap and easy to conduct. These criteria are met by measuring the increased conductivity of milk of inflamed udders in the milking parlour for detection of clinical mastitis, and by routine cow SCC testing and the California Mastitis Test for cases of subclinical mastitis.

Know your bacteria

Successful mastitis control, however, is not granted by early detection of the disease alone. As a second important step the mastitis causing bacteria have to be known.

Why? Simply, because different bacteria cause entirely different disease manifestations requiring different approaches in their prognosis and, consequently, different control strategies.

The most sensitive and specific diagnostic to determine the pathogen is bacteriological culturing (BC). However, it is an expensive method, especially when conducted at quarter level. Cheaper alternatives for BC at the quarter level are composite cow milk sampling or even sampling the bulk milk. The main disadvantage of these alternatives is the loss of information.

The optimum diagnostic strategy for the identification of the pathogen(s) depends on the farm situation.

Where the bulk milk somatic cell count (BMSCC) and the prevalence of clinical mastitis are low, bacteriological culturing of milk samples from the bulk milk tank (BMT) in combination with routine monitoring of cow SCC is a relatively cheap and good way to monitor mastitis and signal problems early on.

Where BMSCC is low while prevalence of clinical mastitis is relatively high, the disease likely involves bacteria that cause temporary, sometimes severe, clinical signs and a short term rise in SCC. Then, E. coli is a likely cause of this mastitis. To confirm this, milk samples of the affected quarter should be analysed. However, when both the BMSCC and the incidence of clinical mastitis are high, the clinical mastitis cases are mainly flare-ups of highly prevalent subclinical infections. In those herds the infected cows and the mastitis causing bacteria need to be identified.

Since BMT milk sample culturing is not giving information on individual cows, here routine individual SCC testing is an easy and inexpensive way to single out infected cows. Additionally, a small number of cows should randomly be sampled for bacteriological culturing. In any event, bacteriological culturing remains an expensive diagnostic. Recent research revealed that thoroughly monitoring and interpreting SCC patterns also provide good, though less detailed information at low costs and in a practical way.

There is a high correlation between mastitis pathogens and their corresponding SCC pattern over time which can give indications on the type of pathogen: the contagious bacteria cause chronic or intermittently high SCC, the environmental more short term high peaks of SCC.

Assess antibiotic sensitivity

Before deciding on a mastitis control strategy, thirdly the antibiotic sensitivity of the mastitis causing pathogen needs to be assessed for effective treatment.

Again, the best but most expensive way to obtain this information is sending milk samples on a regular basis to the regional laboratory for antibiotic sensitivity testing after bacteriological culturing. Less expensive with an almost immediate availability of results would be on-farm testing.

The reliability of commercial test kits available for antibiotic sensitivity testing and their practicality on farm should be investigated by the dairyman before their implementation.

In summary, early detection, bacteriological culturing and antibiotic sensitivity testing as a three pronged approach seems to be a very suitable diagnostic strategy as a basis for efficient mastitis control.

At the end, which diagnostic route to take largely depends on the farmer's willingness to take risks. He must weigh the costs of diagnostics against the information they deliver to get to an optimal diagnostic strategy. ■

Mastitis products – selecting for therapy

When asked what to expect from a mastitis product, high efficacy and a short milk withholding period appear as the most important criteria for product selection. Both, however, depend on a multitude of factors and can, at times, be contradictory.

First and foremost an antibiotic must be effective against the pathogen identified as causing mastitis. Appropriate information on sensitivity of the pathogen to antibiotics need to be generated from a milk sample.

Further, a certain level of distribution and of concentration in milk and in the udder parenchyma has to be achieved to fully reach the pathogen for effective elimination.

Two routes of administration exist for the treatment of mastitis – the treatment directly at the udder (local treatment via intramammary syringe) or via the bloodstream (systemic treatment via an intramuscular, subcutaneous (under the skin) or intravenous injection).

Local treatment is traditionally used as a first line of treatment in almost all cases of mastitis. Official recommendations practised particularly in the Nordic countries, however, consider local treatment rather as additional to systemic antibiotic treatment in case of highly acute and severe clinical cases.

Systemic treatment has recently been found to also be of benefit in treating subclinical mastitis under certain conditions.

Thorough milking just before treatment is a pre-requisite for any local therapy. For treatment success, a sufficient release of the antibiotic is key to reach all affected tissues in efficient concentrations.

Here, the particle size of the active ingredient is crucial: smaller particles result in a better and more even distribution of the antibiotic allowing it to reach distant parts of the parenchyma, while products with large particle size (>40nmm) or uneven distribution of particle size may be inadequate to accomplish this.

This type of information though, as some of the following, is not available through the package insert and to obtain so requires consultation with the veterinarian.

A product suitable for intramammary therapy needs to comply with the following:

- Least possible level of irritation to the udder tissue (sometimes, however, a certain, but low level is considered positive to stimulate an unspecific immune response).
- Efficacy against the bug.
- Antibiotic should bind as little as possible to milk proteins and udder tissue (binding to proteins restricts the drug's activity), but should exhibit sufficient binding to milk lipids (acts as carrier without affecting the drug's activity).
- Quick release of the antibiotic from the formulation.

With a systemic treatment the antibiotic gets into the udder via the bloodstream.

As an advantage all four quarters are targeted (of benefit, when more than one quarter is affected) and the antibiotic is available throughout the entire udder also reaching sections where milk ducts may be blocked by inflammation or abscesses.

The ideal antibiotic should comply with the following:

- As many systemic antibiotic formulas registered for mastitis are based on suspensions, where the active is to be released from particles, again the particle size is an important treatment success factor.
- High availability of the antibiotic from where it is injected: the antibiotic needs to get into the blood quickly to allow sufficient accumulation in the affected tissue.
- Only antibiotics that have no electric load while in the bloodstream are able to cross the milk-blood barrier and reach the affected tissue (for example penethamate as the non-dissociated form of penicillin crosses the barrier and reaches the udder tissue where it dissociates into the active penicillin and a salt).
- Efficacy against the causative bacteria.
- Low binding to plasma proteins, but good solubility with lipid compounds.

Following the above requirements ensures a high availability and efficacy of the antibiotic where it is needed.

It then becomes obvious that antibiotics for systemic treatment with a zero milk withholding period are questionable to result in a successful treatment of a mastitis solely contained to the udder. ■

Effective control of inflammation pays

Losses and damages caused by clinical mastitis are widely known, such as reduction in milk yield and quality, increased rate of culling, elevated production costs from treatment and milk discard as well as negative impact on fertility, if mastitis occurs in the early stage of lactation.

The economic impact of mastitis is directly linked to the effects of inflammation associated with the original infection.

Excessive or lingering inflammatory processes in the end result in irreversible damage to affected udder tissue, impacting its physiological functions and thus the cow's productivity.

In acute mastitis clinical signs are usually obvious and severe.

Acute mastitis is not only caused by E. coli but also by streptococci and staphylococci.

Those pathogens and especially their toxins induce the typical clinical signs of inflammation – fever, impaired demeanour, atonic rumen, pain and up to massive local inflammation of the affected quarter.

Recent research revealed that next to inflammation pain is present also in moderate and even mild mastitis.

Moreover, it was demonstrated that direct pain as a result of inflammation can be followed by a state of hypersensitivity in tissues affected by mastitis, which may persist well beyond the initial period of inflammation.

It may be concluded that this severely reduces the cow's willingness to accept milking equipment and to release milk possibly long after the initial event of mastitis is cured.

In addition to potential irreversible damage to the udder tissue caused by the inflammation, subsequently, the return to full milk performance may be further slowed. NSAIDs (Non Steroidal Anti-Inflammatory Drugs) have been demonstrated to be very instrumental and effective in controlling inflammation and reducing its negative effects.

As a result, the restoration of the cow's condition and well being and, consequently, its ability to perform are accelerated.

Historically, NSAIDs have particularly been used in cases of acute toxic coliform mastitis.

In this respect, NSAIDs have demonstrated their efficacy in controlling the formation of endotoxin triggered inflammatory mediators.

Recent research has proven that this efficacy is not limited to E. coli mastitis, but is of essential value in all types of clinical mastitis.

Furthermore – and sparked by animal welfare considerations – the impact of pain and the need for control of pain and the subsequent hypersensitivity associated even with mild and moderate mastitis have been highlighted.

A recently conducted field study demonstrated a highly significant and lasting effect of a single dose of meloxicam in reducing pain and hypersensitivity in mastitic cows.

With choices given, the duration of action – at full efficacy – and convenience in administration (dose volume, number of injections required to achieve full control of inflammation) are important criteria when selecting the NSAID.

The use of NSAIDs in clinical mastitis, especially a long acting product, may have a stronger indication than previously thought to reduce pain, and to restore well being and productivity in dairy cows suffering from mastitis. ■

Drying off – in theory and practice

The necessity to dry off cows at the end of lactation is considered good practice: the cow is allowed to redirect resources from milk production to the growing fetus and to build body reserves, and the udder tissue can to reconstitute in order to prepare for the next lactation.

Recent experiments comparing dried off cows to cows that have been milked continuously until freshening have demonstrated a considerably lower peak milk performance in non-dried off cows. There are, however, some bacteriological risks associated with drying off:

- Presence of existing (noticed or unnoticed) mastitis from earlier in the lactation.
- Mastitis during dry period, either due to flare ups of persistent infections or as a result of a newly acquired infection.
- Clinical mastitis shortly after freshening as a result of an infection acquired during the dry period.

These risks usually require the adoption of a dry cow therapy plan involving an appropriate intramammary dry cow antibiotic. Here, two main options exist according to farm specific needs and conditions: a blanket (antibiotic dry cow therapy for all cows) approach is advised, if herd udder health parameters suggest so (a high rate of cows in herd with Somatic Cell Count (SCC) of more than 300,000 or continued movement towards a higher bulk milk SCC, a bacteriological herd history for a certain pathogen, high average incidence of clinical mastitis).

If herd parameters are generally below critical levels, a selected dry cow treatment program can be used based on the udder health assessment of the individual cow.

Historically, contagious pathogens such as Staphylococcus aureus and Streptococcus dysgalactiae were considered key issues to be prevented by dry cow therapy.

Recent British data however, indicate that the rate of new infections acquired during the dry period and resulting in clinical mastitis shortly after subsequent freshening which can be attributed to environmental pathogens (including E. coli) is not trivial. Consequently, when selecting for an appropriate dry cow product, thorough thoughts should be given to the length of protection a product can give (6-7 weeks) and the range of pathogens that it is able to control (to include E. coli).

How to dry off

Animals should be checked in time (two weeks) before drying off for udder health status. When clinical symptoms, SCC levels (exceeding the 200,000 mark for the last three readings), CMT test results or information on bacteriology indicate the presence of infection/mastitis, an appropriate antibiotic therapy must be performed.

- Shortly before drying off, the udder health should be reassured.
- Dry off should be done completely in one step, no gradual drying off.
- At drying off (6-7 weeks prior to freshening) udders should be stripped out thoroughly and entirely.
- Inject a dry cow tube per quarter after proper cleaning of teats.
- An internal teat sealer can provide additional protection.
- Move animals to separate and dedicated dry cow section.
- Check on animals regularly during dry period, keep clean environment.
- Consider using external teat dipping on a regular basis.