

MASTITIS THERAPY ON FARM - KEEPING UP WITH THE MOVING GOAL POSTS

ANDREW BIGGS, The Vale Veterinary Centre, Station Rd, Tiverton, Devon EX16 4LF

SUMMARY

Attitudes to treating mastitis have changed in response to techniques of therapy and more recently in response to marketing needs for milk. This has led to a need to re-assess the types of treatment available and the aims of using any form of treatment. Different approaches are recommended for different conditions. Aggressive treatment may be used to tackle infections by *Streptococcus uberis* or *Staphylococcus aureus*, if they are likely to be persistent as disease or sub clinical mastitis. In future, the effectiveness of treatment should be improved by better detection and understanding of infection dynamics. However, prevention rather than treatment should remain the priority.

INTRODUCTION

Approaches to therapy on farm have evolved considerably from the pre-antimicrobial era where symptomatic treatments such as massage, use of embrocations and “stripping out” were all that was available. The discovery of antimicrobials heralded a new era and hopes were that mastitis would be eliminated. However the prevalence of infected quarters on any farm is a result of two factors, the *new infection rate* and the *duration of infection*. Both of these factors can be influenced by antimicrobial treatment, either during lactation or at drying off, and by management control strategies such as teat dipping, culling policy, keeping a well maintained milking machine and general levels of hygiene. Increasingly antimicrobial therapy (both milking and dry cow therapy) is matched to the pathogen profile on a farm. The financial penalties based on bulk milk somatic cell count (BMSCC), levied at a producer level, have increased over recent years and the more recent reduction in UK milk price has made these penalties of increasing significance to farm profitability. The ability to finely control individual cows cell counts is becoming of paramount importance. As a result effective and accurate early identification of infection, often by laboratory tests, the selection of specific antimicrobial therapy, again often based on laboratory tests, and the application of a specific treatment regime will become an important part of herd mastitis control. As an adjunct to treatment, appropriate advice on the relevant management control measures to be reviewed can be given in the light of the epidemiological knowledge of the predominant bacteria involved. This will help stop infection spreading to other uninfected cows in the herd. By using this approach both *duration of infection* and *new infection rate* are closely scrutinised.

TYPES OF “TREATMENT” AVAILABLE

Self cure

Self cure is perhaps more common than is often supposed. Despite the fact that the teat orifice is continually being challenged and penetrated by bacteria the cow's normal defence mechanisms make establishment of infection a relatively rare occurrence. It is also possible for infections to become established and then be eliminated by self cure at a later date. It is clear that on occasions things get better despite what we do rather than because of what we do.

Treatment during lactation

Historically, treatment during lactation involved regular “stripping out” of the infected quarter, application of various topical treatments and massage to encourage the “circulation”. The advent of antimicrobials brought a “magic bullet” approach and drugs were developed with varying degrees of efficacy against the common mastitis causing pathogens.

It appears that the “normal” three tubes used for a treatment course has become part of mastitis history but it is difficult to find any reference to the logic by which this three tube approach was chosen. Initially one tube was infused and only repeated if necessary depending on the clinical response. Gradually it became common place for “data sheets” to suggest three tubes were infused at 24 hourly intervals (every other milking). Latterly the “data sheet treatment regimes” have tended to move towards three tubes infused at 12 hourly intervals (every milking). It is felt that more “aggressive” therapy in the early stages of infection (12 hourly tubing) gives a better chance of a bacteriological cure. This approach also benefits the producer by shortening the duration of treatment and thus reduces the amount of milk discarded during treatment and milk withhold period.

In an attempt to achieve clinical, bacteriological and cell count “cure” various treatment regimes have been employed. These types of treatment regimes are used where infections are known to be refractory to treatment and may have resulted in previous treatment failures, recurrent clinical cases or persistently elevated somatic cell counts. Any variation from the “data sheet recommendations” will result in voiding the validity of the drug companies published withhold period. It is important to note that even increasing the number of tubes infused during a course of treatment will mean that individual cows will have to either have a “standard” milk withhold period applied, currently one week, a withhold period calculated or their milk tested by a suitable “inhibitory substance test” prior to returning their milk to the bulk tank

Self cure and prompt treatment during lactation predominantly affect the *duration of infection*, by eliminating the infection from the affected quarter. However by eliminating infections from mastitic quarters a *reduction in new infection rate* is also likely because, as there are fewer infected quarters present in the herd, the chance of spread of infection is reduced.

Treatment at drying off

Infusion of antibiotic in all quarters at drying off (Dry Cow Therapy) is one of the key points in the NIRD 5 point mastitis control plan and has been used successfully for almost 30 years. This treatment fulfils both of the most important criteria for disease control namely *reduction of the duration of existing infections* and *reduction of the new infection rate*. Antibiotic therapy at drying off is more likely to be successful at eliminating intra-mammary infections than antibiotic therapy during lactation.

Eliminating existing infections (reducing duration of infections) can be of importance with contagious infections such as staphylococci and streptococci. Many cows infected during lactation do not show signs immediately and in some instances may not have a clinical episode for the whole lactation. The infection remains sub-clinical. Some infections do not result in consistently elevated cell counts. Protection of the dry udder (reducing new infection rate) can be of importance with infections such as *Streptococcus uberis* or those that cause summer mastitis. *Staphylococcus aureus* treatment efficacy declines as the cow increases in age so it is imperative to try and keep cows free from *S. aureus* for as long as possible. This coupled with the fact that cows are very susceptible to new infections during the first two weeks of the dry period, especially to *Str. uberis*, means that it is advisable that all cows in the herd receive dry cow therapy. Unfortunately the cow is also very susceptible to infections during the last two weeks of the dry period but to ensure milk produced after calving is free from antibiotic residues protection can not be afforded right up to the point of calving.

Culling

Removal of chronically infected cows is also one of the points in the NIRD 5 point mastitis control plan. Culling predominantly affects the *duration of infection* by eliminating the cow and thus the infection from the herd. However, by removing infected cows from the herd, the new infection rate is likely to be reduced because the chance of spread of infection is also reduced.

THE AIMS OF TREATMENT

This is the area where the goal posts have moved most. Take the statement “Early treatment is crucial to get the best chance of success”. What meant by early and success can be considered to give some idea how things have changed.

Early can be taken as “at the first signs of abnormality”. For clinical mastitis this would be visible changes (e.g. clots in the milk or a swollen quarter). For sub-clinical mastitis this would require laboratory tests. (e.g. elevation of somatic cell count SCC and or the isolation of mastitis causing bacteria)

The aims of successful treatment have evolved as the identification of mastitic cows has become more discriminate. Cows with a slightly elevated SCC, which only a few years ago would have been deemed to be normal, are now known to be sub-clinically infected. Success is no longer to make the milk visually normal. Elimination of causal bacteria and return of cell count to acceptable levels are essential if the long term aim of herd mastitis control, to produce consistently milk to the high standards required by today’s market place, is to be achieved. Even when a clinical cure has been achieved, “Post

Treatment Checks” are an important part of monitoring whether treatment has been completely successful. These should involve bacteriological screening of milk, say one week after the milk is returned to production, and careful monitoring of individual cow SCC after treatment. Repeating bacteriological sampling may be necessary if the SCC response is transient or poor.

SELECTING COWS FOR TREATMENT

In addition to the “normal” new clinical infection which receives three tubes of antibiotic and is cured, there are two areas which justify special attention, persistently infected cows and sub clinical infections.

Persistently infected quarters - carrier cows

These cows are infected with a chronic long term infection. Persistently elevated SCC or repeated isolation of the same pathogen despite treatment will help differentiate these cows from transiently infected cows, which may have either self cured or responded to treatment. Carrier status is most likely to be caused by *S. aureus* or *Str. uberis*. Other streptococci such as *Streptococcus dysgalactiae* or *Streptococcus agalactiae* can be relatively easily eliminated from individual infected quarters with antibiotic therapy. *Str. agalactiae* can also be eradicated from a herd as it is virtually an obligate parasite of the bovine mammary gland, whereas most other mastitis pathogens have other reservoir sources and so herd eradication is not an achievable goal. However these carrier cows pose a significant infection risk to the rest of the herd and as culling is the only alternative they will often justify the increased expense of a specifically tailored treatment regime.

These regimes are either a form of “Extended Therapy”, where treatment is prolonged in an attempt to improve success rates, or “Combination Therapy”, where parenteral therapy (usually by injection) is combined with intra-mammary tubes to improve the penetration of the udder tissue and improve success rates.

S. aureus

If a new *S. aureus* infection is not eliminated, the bacteria may penetrate the mammary gland tissues inducing a response involving walling off the area and forming scar tissue. These areas of scar tissue are difficult for drugs to penetrate to an effective concentration. The invading bacteria may also avoid the killing effects of most, if not all, antibiotics by surviving within the white blood cells (neutrophils). Many organisms become inactive but are not killed by the neutrophil or even by antibiotics that are reported to penetrate the neutrophil. It is thought that the bacteria “hide” within the mitochondria of the neutrophil (a structure within the cell) and thus are still inaccessible to the action of even these antibiotics. The bacteria may remain inactive in the neutrophil until the cell eventually dies, in infected tissue this may be within 5-7 days. They are then released to resume cell division and the infection process.

These factors make *S. aureus* a difficult infection to treat and are cause enough to result in the usual dismal bacteriological cure rates. It has been suggested that of the *S. aureus* infections which have been successfully clinically cured (the milk looks normal and there is no swelling or heat of the udder) only one third (33%) will have been successfully bacteriological cured. Of more concern are the two thirds (66%) which are still infected and pose a risk to the rest of the herd.

Most specific regimes for *S. aureus* involve “Extended Therapy” in an attempt to prolong treatment beyond the life of the neutrophil and hopefully avoid this reason for treatment failure.

Str. uberis

Minimum inhibitory concentrations (MIC) of antibiotics may be four times higher for *Str. uberis* as compared to other streptococci which cause mastitis. This is further complicated by the fact that *Str. uberis* and other faecal streptococci such as *Streptococcus viridans* can be quite resistant to antibiotics as judged by *in vitro* testing. Other streptococci such as *Str. agalactiae* or *Str. dysgalactiae* are very sensitive to antibiotics and in particular to penicillin. Carrier cows are identified by repeat isolation of *Str. uberis*, in pure growth, from the affected quarter. These cows may be previous conventional treatment failures identified on “post treatment checks”. When treating resilient cases of *Str. uberis*, aggressive therapy using penicillin, erythromycin or framomycin can be useful, especially when given parenterally both by intra-muscular injection and in an aqueous presentation infused in to the infected quarter prior to infusing a compatible intra-mammary tube. Prolonged treatment courses may also improve success rates. These forms of treatment obviously have implications for the milk withholding period to be applied and appropriate steps must be taken before the milk can be returned to the bulk tank. Post treatment sampling (say one week after the milk has returned to the bulk tank) is essential to monitor bacteriological success rates. These persistent *Str. uberis* infections may still fail to respond to even such intensive therapy, and have on several occasions resulted in the cow being culled. Also choice of the most appropriate dry cow therapy by antibiotic sensitivity testing is essential to afford the best protection of the dry udder and to eliminate infections present at drying off.

Sub-clinical infections

The new *clinical* infection rate, if good records are available, is easy to calculate and is based on no previous clinical case being reported for in that quarter. However identifying a new *sub-clinical* infection accurately is more of a problem. Realistically, to be applied practically, it can only be based on available data. Individual cow SCC are available on many farms and can give a good insight in to the apparent new sub-clinical infection rate on a farm. As SCC can fluctuate almost daily, accurate identification of new sub-clinical infections is not possible when using monthly composite sampling. However as the limitations of monthly recording remain constant the trends can still be usefully monitored.

An apparent new sub-clinical infection may be identified in a cow with a previously low monthly SCC which has had an elevated SCC at the latest milk recording. The level of SCC indicating infection is obviously open to debate. A SCC of 200,000 cell/ml in composite milk is becoming increasingly used as the threshold for change of status from uninfected to infected. It is useful to consider cows with a previous SCC below 200,000 cells/ml and having a significant rise to over 200,000 cells/ml as newly infected.

Apparent new subclinical infection

The number of apparent new sub-clinical infections at each recording may be expressed as a proportion of the cows in milk. If this is expressed as a percentage experience suggest that 5 to 10 % would be acceptable. In fact as this is monitored on a herd basis, just counting the number each month is useful and any changes can be noted. On a practical note the easiest way to monitor the number of apparent new sub-clinical infections is to mark them with a highlighter pen on the cell count records each month and note the total for the herd. This gives an indication of how many cows are going from “clean” to “infected”.

Apparent new subclinical infection rate

Taking this one stage further and “moving the goalposts” rather than “trying to keep up with moving goal posts”, monitoring the new sub-clinical infection rate can give an indication as to the “background noise” of infection within a herd. If the number of new sub-clinical infections increases, is this an early warning for clinical cases? If nothing else it must identify that pathogens are increasingly being allowed to infect previously uninfected cows. Care must be taken interpreting the data, and samples from these new sub-clinically infected cows can be very revealing. By using epidemiological knowledge of the predominant bacteria involved, management changes can be made to reduce the chance of continued new infections within the herd. If new sub-clinical infections are predominantly caused by environmental pathogens then attention should be spent “outside the parlour” (cubicle hygiene etc). If contagious pathogens predominate then “cow to cow” spread is worthy of attention (parlour routine, teat dipping etc).

CONSIDERATIONS FOR THE FUTURE

Accurate early identification of infection is key. Although early treatment of any infection always gives a better chance of success, an open mind is essential when interpreting the results as treatment is likely to get the credit for all the “self cures”. Clearly a compromise is needed. If monitoring and identification of the causal organism of apparent new sub-clinical infections is followed through to it’s logical conclusion much can be done in the prevention of infection rather than resorting to treatment. However, treatment of apparent new sub-clinical infections (identified by culturing milk from individual quarters from cows with a rise in cell count) may be justified in certain circumstances and will help eliminate the infections from these cows at an early stage. The decision making process has to take many factors in to account to decide if, in this instance, treatment is to be undertaken (e.g. the type of pathogen involved, the number of similar SCC rises in the herd and risk of infection spreading to other cows in the herd, cost implications with reference to cost of treatment and discarded milk versus potential financial penalties for elevated BMSCC). Cows with a persistently elevated SCC can be considered similarly.

Assuming early detection is accurate and false positive diagnoses are few and rare then there are advantages from early treatment

- Improved welfare (mastitis is painful – even sub-clinical)
- Reduced chance of spread within the herd. (most significant with contagious pathogens)
- Lower production losses.
- Increased chance of clinical, bacteriological and cell count success.

However, there are potential disadvantages of early treatment

- Treatment of cases which will self cure.
- Treatment of false positive diagnoses

Monitoring in the future

Monitoring predominant pathogens in samples from cows with a persistently high SCC, and cows with a recent rise in SCC, will indicate the dynamics of the infection rate. Prevalence may thus be controlled more effectively and, as a result, bulk milk somatic cell counts will also be controlled more effectively.

A clinical case of mastitis is best seen as a failure of the control mechanisms in place on the farm. They will occur, but hopefully not very often. Prevention will remain better than cure.