Beecham Mastitis Series

Modern aspects of sheep mastitis

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Veterinary medicine, its teaching, and hence its application, has been steeped for centuries in well-ordered classification of disease. Thus textbooks elegantly pass from 'aetiology' to 'pathogenesis', from 'clinical signs' to 'treatment' often giving only token obeisance to 'epidemiology' and strategic preventative measures. Physiology and pathophysiology, however, are dynamic phenomena and require a corresponding flexibility of thought, unhampered by the rigid interpretation of linear clinical sequences. Nowhere is this more pertinent than when considering the ovine udder in function and dysfunction.

It can be argued that there is but a single udder disease in sheep, any differences in clinical manifestation being a question of degree. Thus it is likely that there is a continual shift in the status of individual udders from health to disease and *vice versa.*

To date, studies on sheep mastitis have tended to concentrate upon either the bacteriology of the disease or the discussion of clinical cases. In reality, this approach only reveals the 'tip of the iceberg' and does not readily translate into practical terms.

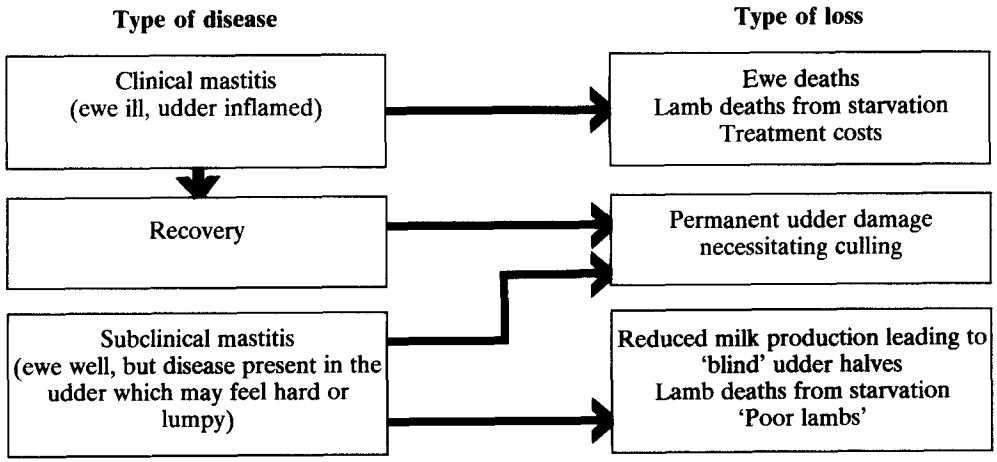
ECONOMICS

Unless they are involved with flock health schemes, most veterinary surgeons have relatively little to do with sheep mastitis. Clinical cases are occasionally seen, but the majority are uneconomic to treat and do not receive veterinary attention. This lack of involvement, however, does not mean that the disease is unimportant. Table I summarizes the problem of sheep mastitis and its overall impact on flock production.

Clinical cases of mastitis are, of course, a source of major financial loss to the shepherd, but they represent only part of the overall cost of mastitis. Far more important economically are:

1) the premature culling of ewes owing to udder abnormalities,
2) the potential effect of reduced milk yields (caused by subclinical mastitis) on lamb viability and performance.

Table I
The cost of mastitis



OCCURRENCE

Madel (1981), in an abattoir survey of 1650 mammary glands from culled ewes, recorded clinically-obvious lesions in 12·8%, of which most were abscesses. He concluded that 'abnormalities of the udder, particularly those associated with infection, are an important reason for culling of ewes' (Table II).

Table II
Reasons for culling ewes in a typical lowland flock*

	n	%
Udder problems	66	46
Barren	52	37
Poor milking/mothering	11	8
Poor body condition	8	6
Feet/legs	2	1
Miscellaneous conditions	3	2
Total	142	100

*Beecham Animal Health data on file.

A conscientious shepherd can detect most clinically-significant lesions by palpation of the udder. Unfortunately this may be of retrospective use only because it is an indication of past udder disease, rather than any 'subclinical' mastitis present at the time of examination.

In a survey of sheep losses in the north of Scotland, Johnston, MacLachlan & Murray (1980) suggested a figure of 8·4% to represent the percentage of total ewe deaths caused by mastitis. Of more significance, however, was the percentage of all *lamb* deaths resulting from starvation/exposure—an average of 34·2% over the lambing season in 1973 to 1976 (Table III).

Table III
Lamb deaths from starvation/exposure*

Year	*% lamb deaths*	*Predominant weather conditions*
1973–74	30·9	Dry and sunny
1974–75	36·7	Cool wet and windy, snow
1975–76	34·3	Very wet and cool

*(Johnston *et al.*, 1980).

The small annual difference in the figures is most likely to be a reflection of the prevailing weather conditions but it is significant that even in a dry and sunny year the lamb deaths from starvation/exposure were 30·9%. This suggests that it is starvation rather than exposure which accounts for the majority of deaths.

It is fair to extrapolate from these facts that insufficient milk supply from the ewe as a result of udder pathology must be an extremely significant factor in lamb mortality; this observation is supported by the authors of the survey.

SIGNIFICANCE

In the past, workers (Buswell & Yeoman, 1976; Hendy *et al.*, 1981) have demonstrated a beneficial effect by infusing ewes' udders with antibiotic at weaning; but bacteriological and clinical assessments have been made at tupping rather than being followed through to subsequent lambing, which is the more appropriate time for evaluation. They have therefore only partly answered the following questions:

1) What is the natural history of pathogenic bacteria in the ovine udder? Indeed, which organisms are pathogens?
2) Does the shepherd's physical assessment of the udder provide sufficient correlation with its bacteriology and the ultimate fate of the ewe?
3) Does intramammary infusion of ewes at weaning influence the occurrence of subclinical mastitis in general and acute, clinical mastitis often seen in ewes prior to lambing, in particular?
4) What are the benefits to the farmer of improving the overall health status of the udders in his flock?

BACTERIA

As a general rule, the overall level of infection within a flock is consistently less than that found in a herd of dairy cows. This is probably explained by current husbandry practices in that sheep are rarely milked on a commercial basis (although the practice is increasing) thereby not having animal-to-animal contact via the milking machine. They are also not subjected to a seasonal build-up of 'environmental' pathogens during their lactational cycle.

Table IV shows that, in spite of the variety of organisms which may be isolated from the ovine udder, there is a basic pattern of distribution which pertains, in broad terms, irrespective of geographical location, but is affected to some degree by the stage of lactation at which udders are sampled. Thus *Staphylococcus aureus* is the predominant organism, with pasteurellae, corynebacteria and streptococci of secondary importance.

Coagulase-negative staphylococci, which have always been considered to be non-pathogenic, are definitely capable of producing clinical disease in sheep. Similarly *Bacillus* spp., often described as 'contaminants', are frequently isolated from abnormal udders and should thus be considered to be of importance. Isolations of *Bacillus* spp., and other herbage-associated bacteria, increase at weaning and this is probably associated with the fact that ewes are at pasture at this time.

ACUTE CLINICAL MASTITIS

The factors predisposing to acute clinical mastitis in sheep are poorly understood. Teat damage and teat lesions are the most significant causes in that they enable pathogens to colonize and gain entry into the teat canal, thereby establishing infection. Thus acute mastitis often accompanies orf infections or excessive 'crutching' which predisposes to chilling of the udder tissue and chapping of the teats.

The diagnosis, pathology and clinical signs of acute mastitis are well known (Madel, 1983). The course of the disease is rapid and its effects severe, so much so that treatment is invariably directed at saving the life of the ewe in the full knowledge that changes to her affected udder tissue are irreversible.

Prevention of acute mastitis entails a high standard of shepherding, cleanliness in lambing areas and good sound management to prevent trauma to udder tissue, particularly the teat ends.

SUBCLINICAL MASTITIS

It has only recently been acknowledged that subclinical mastitis exists in sheep. Ironically too, it has only been as a result of its successful treatment and prevention using strategic intramammary therapy and intelligent culling, that the full extent and economic ramifications of subclinical ovine mastitis have been appreciated (Buswell & Yeoman, 1976; Hendy *et al.*, 1981; Buswell & Watson, 1983). Control

Table IV
Bacteria isolated from the ovine udder

	% of isolates		
	*n = 126**	*n = 23†*	*n = 50‡*
Staphylococcus aureus (coagulase +ve)	26·2	65·3	16·0
Staphylococcus spp. (coagulase −ve)			26·0
Corynebacterium pyogenes	19·8	4·3	—
Corynebacterium spp.			—
Streptococcus spp.	11·1	4·3	8·0
Pasteurella haemolytica	—	21·8	8·0
Pasteurella multocida	—	21·8	8·0
Escherichia coli	8·7	—	2·0
Pseudomonas aeruginosa		—	—
Bacillus spp.	26·2	—	30·0
Proteus spp.	—	—	6·0
Others (including *Neisseria, Micrococcus, Acetinobacter*)	8·0	4·3	4·0

*Scottish Border country (Gibson & Hendy, 1976).
†South East England (Madel, 1983).
‡Midlands and South East England (Buswell & Watson, 1983).

of this disease prolongs the useful working life of ewes by eliminating infection from the udder during the most susceptible post-weaning dry period and allowing 'clean', more productive udders to be presented at the subsequent lambing. In turn, this improved udder status can enhance the viability of lambs, by reducing starvation through shortage of milk and improving their growth rate during the first few weeks of life.

FARM STUDIES ON SUBCLINICAL MASTITIS

Studies were carried out in two lowland flocks; the first consisting of 800 ewes and the second, a younger flock, of 330 ewes. The basic protocol was identical for both farms (Fig. 1) and the following observations are based upon results from these two trials.

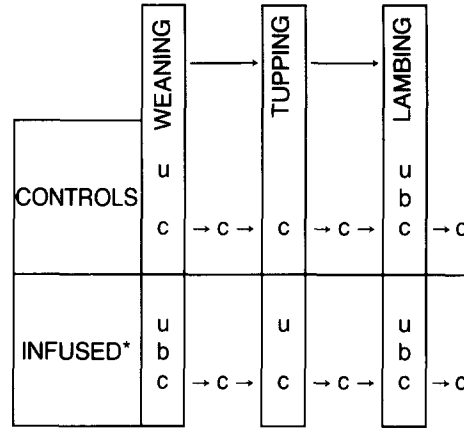


Fig. 1 Schematic protocol of farm studies. u udder examination, b bacteriology, c sampling and recording of clinical mastitis cases. *Ewes infused with 200 mg sodium cloxacillin (Orbenin L. A.) per udder half.

Observations

The occurrence of clinically-palpable udder abnormalities, and associated positive bacteriology, increased with age. There was a point where this correlation broke down, for in very old sheep (e.g. eight years) previous radical culling probably determined that only the healthiest individuals survived (Table V).

Following infusion at weaning, the percentage of udders with palpable lesions was halved by tupping time. This trend continued through to lambing.

At weaning, the predominant organisms isolated from udders of both clinically and subclinically-affected sheep were *Bacillus* sp. followed by coagulase-negative staphylococci. By lambing time, however, the pattern had changed and staphylococci, pasteurellae and streptococci were of significance. This alteration in flora reflects the difference between bacterial challenge to ewes on pasture at weaning (*Bacillus* spp.) and that of ewes housed at lambing (*Staphylococcus* spp., *Pasteurella* spp.) (Table VI).

At lambing, isolates from ewes which had been infused with 200 mg sodium cloxacillin (Orbenin L. A., Beecham Animal Health) per udder half at weaning were extremely low (1%, including a persistent *Staph. aureus*

Table V
Correlation between age, udder condition and bacterial isolates

	Weaning		*Tupping*	*Lambing*	
Age years	*Udder abnorm.* %	*Positive bact.* %	*Udder abnorm.* %	*Udder abnorm.* %	*Positive bact.* %
Yearlings	6·0	2·0	0	4·0	0
2	4·5	6·0	3·5	1·0	0
3	14·5	7·0	8·0	3·5	0
4	35·0	12·0	24·0	7·0	0
8	15·0	11·0	4·0	2·5	5·0
Average	13·0	8·0	7·0	3·0	1·0

Table VI
Bacteria isolated from ewes

	Weaning	*Lambing*	
	Pre-infusion	*Control*	*Infused*
Bacillus spp.	15	—	—
E. coli (non-haemolytic)	—	1	—
Micrococci	—	1	—
Neisseriae	—	1	—
Pasteurella haemolytica	—	3	—
Pasteurella haemolytica (plus *St. viridans*)	—	1	—
Proteus spp.	2	—	1
Staphylococcus aureus (coag +ve)	2	5	1
Staphylococcus aureus (coag −ve)	11	—	2
Streptococcus faecalis	1	—	—
Streptococcus uberis (plus non-haem coli)	—	2	—
Streptococcus viridans	1	—	—

infection) and no clinical mastitis cases were reported in this group. This was in contrast to a 3·5% infection rate, including many clinical cases, in the non-infused control ewes.

Coagulase-negative staphylococci remained an enigma. In one flock they certainly seemed to exhibit a 'self-cure' phenomenon, with 38% of non-infused udders eliminating the infection. However, the comparable figure was 80% in cloxacillin-infused udders which demonstrated that therapy significantly enhances what may be a natural process of recovery from infection.

As a sequence to the trial work, the lamb crop in the succeeding year for both infused and non-infused ewes was compared. Although no statistically significant differences were established, there was a sliding scale advantage effect from single lambs to triplets in average daily liveweight gain in the 'infused' group compared to control animals in equivalent groups (Table VII).

These observations are typical for most lowland flocks within the British Isles and they highlight the important features of subclinical mastitis in sheep.

Table VII
Effect of udder infusion of ewes on lamb weight gains

		n	*Mean daily wt. gain g*	*% advantage*
Singles	Infused	17	342·88	+7·24
Singles	Control	22	319·73	—
Twins	Infused	87	272·51	+3·79
Twins	Control	102	262·57	—
Triplets	Infused	18	218·17	+1·32
Triplets	Control	18	215·33	—

MONITORING SUBCLINICAL MASTITIS

Udder palpation

Routine palpation of the udder at lambing, weaning and tupping by a sensitive shepherd is a useful screening procedure, and in skilful hands there is good correlation beween palpable gross abnormalities of the udder and ewes which should be culled because they are unlikely to provide sufficient milk at the next lactation. Sheep exhibiting these signs, however, rarely show signs of illness.

Cell counting

Recently, there has been increasing interest in the production of ewes' milk for human consumption. This in turn has initiated an increased awareness of subclinical mastitis and the possibility of counting the somatic cells in ewes' milk. Green (1984) considered that cell counting is a feasible exercise using a Coulter Counter and concludes that milk from any gland with a cell count in excess of 10^6 cells/ml should be examined bacteriologically.

California mastitis test (CMT)

Workers in the USA (Gross *et al.*, 1978) found the incidence of positive CMT to be random at lambing with respect to age and line of ewe, number of lambs born and weaned, and sex of lambs; but three to seven weeks after lambing the CMT increased with the age of the lamb and the number of lambs born. There were indications that positive CMT scores were associated with lamb losses, although it was not possible to tell if mastitis was a cause or an effect of lamb loss.

CONCLUSIONS

There is much more work to be carried out before complete answers can be given to all the questions raised earlier in this paper. It is obvious that sheep mastitis does not share many of the features of its counterpart in cattle; the distribution of pathogens, their natural history and the factors determining the initiation of infection are all different. One common feature does emerge, however, and this is the usefulness of strategic antibiotic therapy in the control of mastitis. In flocks where udder infection or udder abnormalities are a major reason for culling ewes, intramammary infusion at the time of weaning is a practical and cost-effective exercise.

There can be no substitute for good husbandry in the control of mastitis; the udder is a delicate organ and as such deserves careful handling and thoughtful management. Thus a good, conscientious shepherd, of gentle disposition, is probably the best control measure of all.

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