A comparative observational study on the reproductive performance of dairy cows with metritis and normal cows

Dirk C. Lourens

Section of Herd Health, Department of Theriogenology, Faculty of Veterinary Science, University of Pretoria, Private Bag X04, Onderstepoort 0110, Republic of South Africa

Received 22 September 1994; accepted 14 March 1995

The reproductive performance of cows with post parturient metritis treated systemically with long-acting oxytetracycline was compared with normal herd mates in four South African dairy herds. The incidence of metritis for all calvings in these herds was 7.5% (of 1838 calvings), 3.6% (of 715 calvings), 4.6% (of 455 calvings) and 2.8% (of 357 calvings), respectively. The comparative median days to first insemination and conception between normal and metritic cases in the largest herd were 75 versus 85 and 92 versus 140, respectively. On average, more inseminations per conception (2.06) were needed for metritic cases when compared with normal herd mates (1.52) in this herd. These differences were statistically significant ($P < 0.01$). No significant differences in these parameters were apparent between metritic cases and normal herd mates in the other three herds.

Die vrugbaarheidsprestasie van koeie met post partale metritis wat sistemies met langwerkende oksitetrasiklien behandel is, is met normale kuddemaats in vier Suid-Afrikaanse melkkuddes vergelyk. Die insidens van metritis vir alle kalwings was onderskeidelik, 7.5% (uit 1838 kalwings), 3.6% (uit 715 kalwings), 4.6% (uit 455 kalwings) en 2.8% (uit 357 kalwings). Die mediane dag tot eerste inseminasie en konsepsie tussen normale en metritis gevalle in die grootste kudde was onderskeidelik, 75 versus 85 en 92 versus 140 dae. Gevalle van metritis in hierdie kudde het gemiddeld meer inseminasies per konsepsie (2.06) benodig as normale kuddemaats (1.52). Hierdie verskille was statisties betekenisvol ($P < 0.01$). In die ander drie kuddes was daar geen betekenisvolle verskille tussen metritis gevalle en normale kuddemaats ten opsigte van hierdie parameters nie.

Keywords: Dairy herds, metritis, multifactorial, reproductive performance.

Introduction

The puerperium is an important period in the reproductive life of the dairy cow because of its influence on subsequent fertility. Many factors including periparturient diseases contribute to the reproductive efficiency of dairy herds. These diseases are probably the most important and most difficult to control in modern intensive dairy farming owing to their complex multifactorial nature (Curtis & Erb, 1985; Erb *et al.*, 1981; Gröhn *et al.*, 1990).

Metritis is a commonly diagnosed disorder of the post partum period. Despite the best efforts to optimize management and the use of antibiotics, metritis still remains an economically significant problem in intensive dairy farming systems. Although the mortality is low, systemic involvement leads to decreased milk production as well as to direct treatment costs and losses from unsaleable milk as a result of antibiotic residues (Bartlett *et al.*, 1986).

Metritis increases the calving to conception interval as well as the services per conception which leads to losses from reduced milk production associated with longer intercalving intervals, higher insemination costs and increased culling rate. While the correct course of therapy is important to limit these losses as far as possible, efforts should be made to prevent metritis by the simultaneous manipulation of all or of as many determinants as possible associated with the host, the agent and the environment (Bartlett *et al.*, 1986; Curtis & Erb, 1985; Erb *et al.*, 1981; Gröhn *et al.*, 1990; Martin *et al.*, 1987; Olternacu *et al.*, 1990).

The objectives of this study were to describe the incidence and subsequent reproductive performance of cows with non-specific metritis treated systemically with long-acting oxytetracycline for calvings over a five-year period in four commercial South African dairy herds, and to compare the reproductive performance of these metritic cases with normal herd mates within each herd.

Materials and Methods

Herds

Retrospective data concerning 1072 primiparous calvings and 2 293 multiparous calvings (total 3365) were collected from January 1987 through to December 1991 in four commercial dairy herds.

Herd 1, the largest herd with approximately 300 cows in lactation was an Ayrshire herd in the Pretoria district. Herds 2 (Friesland), 3 (Holstein) and 4 (Ayrshire), with approximately 100, 80 and 50 cows in lactation, respectively, were all located in the Nigel district of the Eastern Transvaal highveld. All the herds were well managed and the feeding programme on each farm appeared to be good as milk production and herd health was good. The herds were characterized by above average milk yields, excellent general health standards and were brucellosis free. The farmers involved in this study maintained an efficient recording system. The herds had a year-round calving pattern and breeding was done by artificial insemination. The breeding policy was to start breeding at first observed oestrus which occurred at approximately 60 days post partum.

Reproductive programme

Each herd followed a reproductive herd programme with scheduled two-weekly veterinary visits for Herd 1 and four-weekly veterinary visits for the other herds. Categories of cows examined rectally during these visits were post partum cows (i.e. 1 – 4 weeks post partum), open cows selected because of problem histories (previous treatments, no recorded heats, irregular cycles, repeat breeders, etc.) and cows for confirmation of pregnancy.

During routine post partum examinations an assessment of the condition of the cows (condition scoring), lochia, vaginal discharges, size of the cervix, size and tone of the uterus, and size and structure of the ovaries was made and recorded.

The diagnosis of non-specific metritis was based on the subjective clinical evaluation, in relation to the days post partum, of the uterine size, the uterine wall consistency (firmness, elasticity and tone), the uterine wall thickness, the fluid content of the uterine cavity and a fetid reddish-brown serous to purulent vaginal discharge. Metritis often, but not invariably, followed pertinent complications such as retained placentas. Some cases of metritis were characterized by signs of fever, depression, anorexia, dehydration, a drop in milk production, and rumen stasis as sequels to toxaemia and septicaemia. Cows diagnosed as having metritis were treated systemically with long-acting oxytetracycline ('Liquamycin LA', Pfizer) by intramuscular injection at a dosage rate of 20 mg/kg given once only. These cows were re-evaluated at the next routine herd visit.

Cows which had no abnormal event recorded during and subsequent to calving and which were cycling (active ovaries and or recorded heats) were defined as normal. Cows with any abnormal recorded findings other than metritis (i.e. endometritis, cystic ovarian disease, adhesions, etc.) as well as normal cows with true anoestrus (inactive ovaries) were excluded from the analysis (Table 1 — other cases).

Data management and analysis

Routine data (calving dates, results of rectal examinations, oestrus dates, insemination dates, pregnancy diagnosis, etc.) were stored in the DAISY (Dairy Information System) computer program (Early Gate, Reading, Berkshire RG6 2AT, United Kingdom). The key reproductive parameters used in this study (days to first insemination, days to conception and number of inseminations per conception) were generated by the program for each cow.

Relevant data on each case (lactation number, calving dates, diagnostic category, days post partum diagnosis of metritis, follow-up evaluation) and the reproductive parameters for each case were then transferred to the program Statgraphics (Manugistics, 2115 East Jefferson Street, Rockville, Maryland 20852, U.S.A.) for statistical analysis.

Summary statistics on the reproductive parameters were generated by the program for normal and metritic cases in the primiparous, multiparous and all case groups for each herd. Use was made of the Mann-Whitney-U-Test for unpaired data which tests for the significance of the difference between the medians and rankings of two independent non-parametric samples of different size (Steel & Torrie, 1980). Each calving was treated as an independent event or new case. A cow which had metritis, for example, in the previous puerperium must have, of necessity, recovered from the metritis in order to reconceive and recalve.

The following are the definitions for the parameters used:
Percentage of calvings served: The number of cases served divided by the number of calvings expressed as a percentage.
Days to first insemination: The number of days from calving to first insemination.
Percentage of calved conceived: The number of cases which conceived divided by the number of calvings expressed as a percentage.
Percentage of served conceived: The number of cases which conceived divided by the number of cases inseminated expressed as a percentage.
First insemination conception rate: The number of cases conceiving to the first post partum insemination divided by the total number of cases inseminated expressed as a percentage.
Days to conception: The number of days from calving to conception for cases that conceived (i.e. certified pregnant).
Average inseminations per conception: The number of inseminations needed for all conceptions divided by the number of conceptions (pregnant cows only).

Results and Discussion

Incidence

The incidence of metritis (Table 1) for the five-year period varied between 2.6% and 7.5% for primiparous calvings and 2.8% and 7.4% for multiparous calvings for the four herds studied with no clear seasonal pattern in any of the herds. There were no marked differences between primiparous and multiparous calvings. The differences in incidence between herds are expected and suggest that herd origin was a determinant of metritis. It is obvious that the herds differ from each other in many important aspects such as breed, herd size, management, nutrition, sanitary conditions at calving, environmental and climatic factors.

The incidence of metritis found in this study is acceptable for intensive dairy farming systems and is similar to other reports on metritis (Bretzlaff *et al.*, 1982; Gröhn *et al.*, 1990). The recorded incidence of puerperal diseases varies tremendously between 3 and 36% (Bartlett *et al.*, 1986; Callahan & Horstman, 1987; Markusfeld, 1987). In some of these reports, however, no clear distinction has been made between the metritis complex and the more chronic endometritis complex.

The incidence of metritis should always be evaluated within the multifactorial context of the total peripartal period. Any condition which allows for increased bacterial challenge of the uterus, i.e. dystocias, poor calving management, etc., will increase the risk of metritis developing (Curtis & Erb, 1985; Erb *et al.*, 1981; Gröhn *et al.*, 1990; Markusfeld, 1987; Noakes *et al.*, 1991; Olternacu *et al.*, 1990). Underlying this is the general health, hormonal and immune status of the cow which influences the uterine defense mechanism. The uterine defence mechanism depends on the capacity of the uterus to contract and expel lochia, the presence of uterine leucocytes to phagocytose foreign bodies, and the presence of immunoglobulins (Hussian, 1989). The uterus is highly resistant during the oestrus phase. Hence, the onset of the ovarian cycle, which depends to a great extent on the nutritional status of the cow, enhances the uterine defence mechanism (Hussian, 1989; Nakao *et al.*, 1992). Nutrient deficiencies and

Table 1 Incidence, days post partum of diagnosis and clinical recovery rate of metritic cases (P = Primiparous, M = Multiparous and T = Total)

	Herd I			Herd II			Herd III			Herd IV		
Parameters	P	M	T	P	M	T	P	M	T	P	M	T
Number of calvings	624	1214	1838	233	482	715	109	346	455	106	251	357
Number of cases with normal puerperium	425	753	1178	196	375	571	83	280	363	92	216	308
Number of metritic cases	47	90	137	6	20	26	8	13	21	3	7	10
Incidence metritis (%)	7.5	7.4	7.5	2.6	4.2	3.6	7.3	3.8	4.6	2.8	2.8	2.8
Diagnosis and treatment days post partum												
Average	7.85	9.54	8.93	9.17	8.15	8.38	10.13	9.15	9.52	9	7.14	7.7
Median	8	9	9	9.5	9	9	11	10	10	8	7	7.5
Standard deviation	4.70	6.37	5.88	2.99	3.72	3.53	3.48	5.80	4.97	1.73	1.95	2.00
Number and % clinical normal next visit	37 (79)	65 (72)	102 (75)	6 (100)	18 (90)	24 (92)	6 (75)	9 (69)	15 (71)	3 (100)	7 (100)	10 (100)
Number of other cases	152	371	523	31	87	118	18	53	71	11	28	39

excesses as well as extremes of body condition are very important determinants of many peripartal diseases (Curtis & Erb, 1985; Weaver, 1987).

The median value of days in milk at diagnosis and treatment of metritis varied between 7 and 11 days for all cases in the four herds studied (Table 1).

The optimal time for the first post partum examination is debatable. During the early puerperium (i.e. the first 10 days post partum), an accurate assessment of the bovine uterus is subjective and errors can be made. Purulent vaginal discharges may not necessarily indicate a uterine infection but could be part of the self-cleansing mechanism of the uterus (Bretzlaff *et al.*, 1982; Gilbert & Schwark, 1992; Hussian, 1989). This could have resulted in some inaccuracy in the results.

The number of days post partum at diagnosis and treatment depends on the number of days post partum when a rectal examination is actually performed, and the subjective decision as to whether treatment is in fact needed or not. The frequency of herd visits could also have resulted in inaccuracies. If every cow was not examined during the first two weeks post partum, there is a possibility that some cows with metritis were not timeously diagnosed and had undergone a spontaneous cure by the following examination. Currently, however, rectal palpation and physical evaluation of vaginal discharges remains the most widely used and practical method for diagnosing puerperial diseases but it is not the most reliable for research. It is thus acknowledged that the case definitions used in this study are subjective owing to the clinical nature of diagnosis.

The need to treat all cases of 'metritis' can also be debated when one considers the uterine defense mechanisms. On the other hand, when one considers the possible complications and potential severity of metritis, it is generally acknowledged that the sooner metritis is diagnosed and treated, the less adverse the detrimental effects will be. The choice of various treatment regimes is controversial although the therapeutic objectives are well established, namely: to protect the immediate health of the cow, to minimize the complications and to improve the subsequent fertility performance of the cow with metritis (Bretzlaff *et al.*, 1982; Bretzlaff, 1987; Callahan & Horstman, 1987; 1993; Gilbert & Schwark, 1992; Gustafsson, 1984; Ott, 1986).

The range of metritic cases classified as 'clinically normal' at the next scheduled reproductive examination varied between 71% and 100% depending on the herd being considered (Table 1). No conclusions on the effectiveness of treatment can be drawn from these results owing to the fact that this was a descriptive study with no controls for comparison.

Reproductive performance

There were no significant differences in the reproductive parameters between primiparous and multiparous cases within herds for both normal and metritic cases in the four herds studied. Consequently, the data were combined to condense and simplify the results (Table 2). There were no clear differences between normal and metritic cases within and also between herds of calvings with regard to the percentage of cases served (80 – 94%), the percentage of cases conceived (78 – 85%) and the percentage of cases conceived of cases inseminated (89 – 100%). Thus the overall conception rates were similar for metritic and normal cases.

The comparative median days to first insemination and median days to conception between normal and metritic cases in Herd 1 were 75 versus 85 and 92 versus 140, respectively. On average, more inseminations per conception (2.06) were needed for metritic cases when compared with normal herd mates (1.52) in this herd. These differences were statistically significant ($P < 0.01$), which is in agreement with reported literature (Callahan & Horstman, 1987; Erb *et al.*, 1981; Olternacu *et al.*, 1990). While many factors may have contributed to these differences, it is reasonable to assume that the metritis itself was a major contributor.

While the numbers of metritic cases were small in Herds 2, 3 and 4, it seems that there was no difference in the fertility performance between cases with metritis and normal herd mates in these herds. The apparent success in these herds was

Table 2 Reproductive performance of normal cows and cows with metritis in four dairy herds (N = normal cases, M = metritic cases)

	Herd I		Herd II		Herd III		Herd IV	
Parameters	N	M	N	M	N	M	N	M
Number of calvings	1178	137	571	26	363	21	308	10
Number served	1065	123	515	23	306	19	288	8
Percentage of calvings served	90	90	90	89	84	91	94	80
Days to first insemination								
Average	83	100	67	65	90	88	67	82
Median	75	85	64	61	85	81	63	68
Standard deviation	29.63	62.33	18.53	15.87	25.70	21.44	20.49	38.65
Number conceived	969	109	464	22	284	17	257	8
Percentage of calved	82	80	81	85	78	81	83	80
Percentage of served	91	89	90	96	93	90	89	100
Number conceived first insemination	633	48	289	11	191	11	145	5
First insemination conception rate (%)	65	44	62	50	67	65	56	63
Days to conception								
Average	106	157	89	91	112	113	97	114
Median	92	140	75	86	96	105	81	119
Standard deviation	49.81	82.26	42.30	37.23	54	47.41	47.99	50.50
Average insemination per conception	1.52	2.06	1.62	1.50	1.57	1.41	1.78	1.88

not necessarily due to successful treatment. Again, many factors may well have contributed to this.

The results of this study indicated that herd origin was an important determinant on the subsequent fertility performance of the cases diagnosed with metritis.

When the results on reproductive performance between herds are compared, it is clear that differences in management and other factors on the different farms were an important determinant of reproductive performance. A large number of factors, both known and unknown, could have resulted in differing reproductive performance between herds. The significance of the differences between herds were thus not tested.

The factors which affect the fertility performance in dairy herds have been extensively reviewed. Briefly, the following aspects must always be taken into account when optimal reproductive efficiency is required (Jones & Stewart, 1992; Weaver, 1987; Williamson, 1987):

(a) Management policy of the farmer with respect to length of voluntary waiting period before breeding, heat detection procedures, nutrition, insemination procedures, culling, etc.

(b) Factors which affect the health, condition and eventual fertility of the cow (i.e. nutrition of dry and lactating cow, periparturient management, venerial diseases, milk production, age and condition of heifers at calving, general health, seasonal and climatic conditions).

(c) Efficiency, accuracy and intensity of heat detection.

(d) Factors which affect the efficiency of artificial insemination (i.e. semen quality, technique, timing, flask management, variations between inseminators).

(e) Bull factors with natural services (i.e. fertility, libido, service capacity and venereal diseases).

Conclusions

In spite of the limitations of descriptive studies for research purposes, they have an important practical application for the evaluation of the efficiency of dairy herd health and management programmes. In these programmes, it is important to measure the incidence of clinical syndromes and to monitor performance against set objectives. This is the only way to identify areas of suboptimal performance.

If one only depends on, and over emphasizes antibiotic treatment in the management of diseases such as metritis, then these results stress the variability of the response among herds. The emphasis must focus on the multifactorial nature of diseases seen on dairy farms and the adoption of a holistic method to prevent and control these diseases. Although pathogenic bacteria are the direct cause of metritis, and specific treatment is necessary, it is also very important to manipulate indirect factors (i.e. sufficient causes). If key components such as nutrition and peripartal management are controlled, the incidence of metritis can be minimized, the success of rational treatment will be improved and the losses from decreased fertility performance will be limited.

Acknowledgements

The author would like to thank the farmers, who must remain anonymous, for their cooperation. The author would also like to thank Drs M.G. Snyman and S.J. Terblanche for assistance with the routine rectal examinations, Sr M.E. Louw and Miss A. Olivier for their invaluable assistance with data management as well as Dr D.C. Roberts for proofreading the text.

References

BARTLETT, P.C., KIRK, J.H., WILKE, M.A., KANEENE, J.B. & MATHER, E.C., 1986. Metritis complex in Michigan Holstein

– Friesian cattle: Incidence, descriptive epidemiology and estimated economic impact. *Prev. Vet. Med.* 4, 235.

BRETZLAFF, K.N., WHITMORE, H.L., SPAHR, S.L. & OTT, R.S., 1982. Incidence and treatments of postpartum reproductive problems in a dairy herd. *Theriogenology* 17, 527.

BRETZLAFF, K.N., 1987. Rationale for treatment of endometritis in the dairy cow. *Vet. Clin. North. Am.: Food Animal Practice* 3, 593.

CALLAHAN, C.J. & HORSTMAN, L.A., 1987. Treatment of early postpartum metritis in a dairy herd: response and subsequent fertility. *Bovine Pract.* 22, 124.

CALLAHAN, C.J. & HORSTMAN, L.A., 1993. Treatment of postpartum metritis in dairy cows caused by *Actinomyces pyogenes*. *Bovine Pract.* 27, 162.

CURTIS, C.R. & ERB, H.N., 1985. Path analysis of dry period nutrition, postpartum metabolic and reproductive disorders, and mastitis in Holstein cows. *Dairy. Sci.* 68, 2347.

ERB, H.N., MARTIN, S.W., ISON, N. & SWAMINATHAN, S., 1981. Interrelationships between production and reproductive diseases in Holstein cows. Path analysis. *Dairy Sci.* 64, 282.

GILBERT, R.O. & SCHWARK, W.S., 1992. Pharmacologic considerations in the management of peripartum conditions in the cow. *Vet. Clin. North. Am.: Food Animal Practice* 8, 29.

GRöHN, Y.T., ERB, H.N., McCULLOCH, C.E. & SALONIEMI, H., 1990. Epidemiology of reproductive disorders in dairy cattle: Associations among host characteristics, disease and production. *Prev. Vet. Med.* 8, 25.

GUSTAFSSON, B.K., 1984. Therapeutic strategies involving antimicrobial treatment of the uterus in large animals. *J. Amer. Vet. Med. Assoc.* 185, 1194.

HUSSIAN, A.M., 1989. Bovine uterine defense mechanisms: a review. *J. Vet. Med. Ser.B.* 36, 641.

JONES, R.I. & STEWART, P.G., 1992. Estimating true and apparent number of services per conception, estrus detection intensity and calving interval in dairy herds. *Theriogenology* 37, 1327.

MARKUSFELD, O., 1987. Periparturient traits in seven high dairy herds. Incidence rates, association with parity and interrelationships among traits. *Dairy Sci.* 70, 158.

MARTIN, S.W., MEEK, A.H. & WILLEBERG, P., 1987. Veterinary Epidemiology Principles and Methods. Iowa State University Press/Ames.

NAKAO, T., MARIYOSHI, M. & KAWATA, K., 1992. The effect of postpartum ovarian dysfunction and endometritis on subsequent reproductive performance in high and medium producing dairy cows. *Theriogenology* 37, 341.

NOAKES, D.E., WALLACE, L. & SMITH, G.R., 1991. Bacterial flora of the uterus of cows after calving on two hygienically contrasting farms. *Vet. Rec.* 128, 440.

OLTERNACU, P.A., FRICK, A. & LINDHé, B., 1990. Epidemiological study of several clinical diseases, reproductive performance and culling in primiparous Swedish cattle. *Prev. Vet. Med.* 9, 59.

OTT, J.M., 1986. Treatment of toxic metritis in dairy cattle. *Compendium on Continuing Education for Practicing Veterinarians* 8, S321.

STEEL, R.G.D. & TORRIE, J.H., 1980. Principles and procedures of statistics A biometrical approach. McGraw-Hill Book Company.

WEAVER, L.D., 1987. Effects of nutrition on reproduction in dairy cows. *Vet. Clin. North Am.: Food Animal Practice* 3, 513.

WILLIAMSON, N.B., 1987. The interpretation of herd records and clinical findings for identifying and solving problems of infertility. *Compendium on continuing Education for Practicing Veterinarian* 9, F14.