ARTICLES

Retained Fetal Membranes in the Mare: A Retrospective Study

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Abstract

A retrospective study of 3456 deliveries was conducted from the records of four Standardbred broodmare farms where mares were bred by artificial insemination and maintained under close veterinary supervision. Retained fetal membranes (RFM) were observed in 10.6% of the deliveries. Retained fetal membranes occurred more frequently ($p < 0.05$) after dystocia and in mares which had RFM the previous year. Retained fetal membranes after normal foaling had no significant effect on the reproductive performance (pregnancy rate, pregnancy loss rate, or foaling rate), nor on the general health of the mares, regardless of the duration of RFM (3 to 144 hours). Postfoaling laminitis was not observed. Oxytocin therapy of mares with RFM starting at two hours postpartum significantly reduced the incidence of RFM ≥ 8 hours. Mares with RFM which had received intrauterine antimicrobials between foaling and first breeding had a foaling rate similar to mares with RFM which had not received intrauterine therapy.

Résumé

La rétention des membranes foetales chez la jument : une étude rétrospective

Une étude rétrospective de 3456 parturitions a été conduite à partir des dossiers médicaux provenant de quatre fermes d'élevage Standardbred. Les juments étaient toutes inséminées artificiellement et maintenues sous supervision vétérinaire. On a noté une rétention des membranes foetales chez 10,6% des parturitions. La rétention des membranes se produisit plus fréquemment ($p < 0,05$) chez des cas de dystocie ou bien chez des juments qui avaient eu une rétention des membranes l'année précédente. La rétention des membranes après une parturition normale n'avait aucun effet sur la performance reproductrice (taux de gestation, taux d'avortement ou taux de parturition) ou sur l'état de santé de la jument quelle que soit la durée de rétention (3 à 144 heures). La fourbure post-parturition n'a pas été observée. Une thérapie à base d'oxytocine, débutée à deux heures post-partum, a diminué significativement l'incidence de rétention ≥8 heures. Les juments avec rétention qui ont reçu des médicaments antimicrobiens intra-utérins entre la parturition et le premier accouplement ont eu un taux de gestation à terme et de parturition similaire à des juments n'ayant reçu aucune thérapie intra-utérine.

Can Vet J 1988; 29: 903-910

Introduction

Retained fetal membranes (RFM) after foaling have been reported to be more likely to occur following abortion, prolonged gestation, twinning, dystocia, fetotomy, and cesarean section (1,2,3). It has been postulated that mares bred at foal heat (FH) or mares which have developed uterine or systemic infection before or during pregnancy were prone to retained fetal membranes (4,5). The incidence of RFM and puerperal infections may increase with age, excessive fatigue, poor condition, or poor environment (1,4).

In the cow, the same factors have been recognized (6,7). Other studies demonstrated that RFM occurred more frequently in multiparous cows, after birth of a singleton male, during the months of February and March, in heifers born from cows which had RFM during their lives, and in cows that previously had retained fetal membranes (6,8).

Retained fetal membranes have been regarded as a threat to the uterine health and general health of the mare. The reported sequelae of RFM range from none to metritis, laminitis, septicemia, and death (1,9).

In cattle, the number of services per conception increased after retained fetal membranes (1,10). The conception rate could be diminished by as much as 16% after RFM in primiparous cows (6). However, the conception rate of cows after RFM was almost the same as that of normal cows, unless RFM was complicated by other diseases (8,11,12). An increase in other genital disorders was observed after RFM, and the reproductive life of heifers affected by RFM at first calving was decreased by one year in comparison to heifers which had no RFM at first calving (8).

Manual removal was the most commonly described treatment for RFM in the mare (1,4,13) and six methods were described. Following manual removal, systemic or local antimicrobial therapy was administered along with active or passive immunization against tetanus (1,7). However, serious complications like

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Reprints will not be available.

uterine inversion, prolapse, lacerations, hemorrhage, and infection were observed following undue use of force to separate the fetal membranes from the endometrium (2,11).

Recently, many clinicians have recognized the effectiveness of oxytocin to expel RFM from the mare (2,3,5,9). Oxytocin therapy was recommended within 12 hours after delivery. If hormonal therapy failed, the RFM was to be removed manually (5,7), or allowed to detach naturally (15).

The most recent technique for manual removal consisted of introducing a large amount of diluted antiseptic (9–12 liters) into the allantoic cavity kept closed at the cervical star. The chorioallantois and its fluid content were pushed out by the expulsive efforts of the mare. This technique was described as less traumatic than manual separation of the placenta (16).

It has been recommended that mares with RFM not be bred at FH (9,15) although no reason was given for that recommendation.

The success of different treatments of RFM was always measured in terms of their effectiveness in removing the RFM within a certain time. No study evaluated the methods of treatment in terms of the reproductive future of the mare.

In cattle, manual removal of RFM has been noted to be detrimental to conception rate (17,19). Intrauterine antimicrobial therapy diminished the conception rate of cows after RFM; systemic therapy with antibiotics or no therapy at all resulted in a higher conception rate (18,19).

Most of the reports concerning equine RFM have been based on clinical experience (1,4,5,7). Extensive studies, like those mentioned for cattle, are not available for the horse. We have studied the records of four breeding farms to 1) identify factors associated with RFM in the mare, 2) evaluate the reproductive consequences of RFM in the mare, and 3) determine the effect of uterine therapy and FH breeding on reproduction in mares affected by retained fetal membranes.

Materials and Methods

Data from 3456 deliveries were collected from the records of four Standardbred broodmare farms. The number of deliveries and time period studied on each farm were as follows: Farm A — 1496 deliveries from 1970 to 1976; Farm B — 747 deliveries from 1974 to 1979; Farm C — 730 deliveries from 1966 to 1976; Farm D — 483 deliveries from 1976 to 1979.

Each farm was supervised by at least one resident veterinarian. Deliveries were attended and occurred in a foaling stall with the exception of late abortions or mares which foaled in the paddock during exercise periods.

Data were collected from all reported deliveries of live, dead, or aborted foals. A normal delivery was defined as the natural birth of a single live foal at term, with a grossly normal placenta, and without dystocia or gross injury to foal or dam. Dystocia was defined as delivery requiring assistance. Fetal membranes were defined as retained if they were not expelled completely within three hours after delivery.

The following data were collected for each delivery: 1) name of the mare; 2) foaling date; 3) duration of RFM; 4) problems of foal or dam at foaling, or immediately after; 5) breeding dates; 6) date of pregnancy examination; 7) outcome of breeding (barren, pregnancy, abortion, stillbirth, foaling).

A mare was considered to have received uterine therapy if antibacterial agents were placed in her uterus between delivery and first breeding, preceded or not, by manual removal of retained fetal membranes. A mare was classified as having no intrauterine therapy if she was not treated or if she received only systemic treatment between delivery and first breeding. Systemic treatment included parenteral administration of antibiotics and/or oxytocin.

The reproductive performance of mares with RFM having received uterine therapy was compared with that of mares classified in the nonuterine therapy group on farms B, C and D. In addition, two farms were compared to evaluate the effect of oxytocin therapy on duration of RFM. On farm A, the standard procedure consisted of injecting oxytocin two hours after delivery of the foal and every two hours thereafter until expulsion of retained fetal membranes. If this treatment failed, RFM were removed manually after 12 hours. On farm C oxytocin was not used to treat RFM, but the mares were treated locally and systemically with antibiotics.

Artificial insemination (AI) was used to breed 100 to 600 mares per farm per year. Extenders were added to semen collected by artificial vagina depending on the number of mares to be inseminated. No precise information was available on the type and frequency of use of extenders over the years studied. Foal heat breeding was defined as inseminating a mare during the first 20 days after delivery.

Pregnancy diagnosis was performed by transrectal examination within the first two months after last breeding. Mares were routinely dewormed and vaccinated against tetanus and equine viral rhinopneumonitis.

In order to eliminate factors other than RFM that could have interfered with subsequent reproduction, only mares with normal deliveries (with and without RFM) were used when calculating reproductive performance.

The reproductive parameters measured were first cycle pregnancy rate (PR1), overall pregnancy rate (PRO), pregnancy loss rate (PLR), and foaling rate (FR). The PR1 was the percentage of mares diagnosed pregnant after the first estrus period in which they were bred. The PRO was the percentage of mares diagnosed pregnant at the end of the breeding season. The PLR was the percentage of pregnant mares which subsequently had an abortion or stillbirth. The FR was the percentage of bred mares which had a live foal.

The effect of RFM and FH breeding on these reproduction performances was studied on all four farms. However, the effect of uterine treatment of RFM on these reproductive performances was studied only on farms B, C and D. Farm A was excluded because some of the treatment records between foaling and first breeding were not available.

TABLE 1
Incidence of Retained Fetal Membranes (RFM)[a] in Standardbred Broodmares

	Farm A	Farm B	Farm C[b]	Farm D	Combined
Normal deliveries[c]					
% RFM	8.1[d]	7.2[d]	13.8[e]	16.6[e]	9.9*
No. deliveries	(1394)	(706)	(341)	(433)	(2874)
All deliveries (normal and abnormal)					
% RFM	8.7	7.4	13.4[f]	17.0[f]	10.6*
No. deliveries	(1496)	(747)	(730)	(483)	(3456)

[a]RFM = retained fetal membranes for three hours or more after foaling

[b]The discrepancy in the number of normal and total deliveries at farm C was caused by the inability to distinguish in the records the normal and abnormal deliveries between 1971 and 1976

[c]Normal delivery = natural birth of a single live foal at term with a grossly normal placenta, and without dystocia or gross injury to the foal or dam

[d-f]Chi-square test comparing two farms at a time, results with the same superscript are not significantly different

*Significant differences among farms ($p < 0.005$) with chi-square test comparing all farms simultaneously

TABLE 2
Percent Incidence of Retained Fetal Membranes (RFM)[a] in Standardbred Broodmares after Normal[b] and Abnormal Deliveries Within Each Farm

	Farm A % RFM (n[c])	Farm B % RFM (n)	Farm C % RFM (n)	Farm D % RFM (n)
Normal deliveries	8.1 (1394)[d]	7.2 (706)	13.8 (341)	16.6 (433)
Abnormal deliveries				
Dystocia	16.7 (66)[d]	15.4 (13)	100 (1)	11.1 (9)
Single abortion or stillbirth without dystocia	25.0 (12)	0.0 (21)	15.4 (13)	23.1 (13)
Twinning without dystocia	10.0 (10)	0.0 (0)	33.3 (3)	0.0 (0)
All twinnings	25.0 (12)	0.0 (0)	33.3 (3)	0.0 (0)

[a]RFM = retained fetal membranes for three hours or more after delivery

[b]Normal delivery = natural birth of a single live foal at term, with a grossly normal placenta, and without dystocia or gross injury to the foal or dam

[c]n = number of deliveries studied

[d]Comparison between normal and abnormal deliveries within each farm. Significant differences ($p < 0.05$) between groups with the same superscript

The chi-square test was used for statistical analysis when comparing groups. When the number in one cell was smaller than five, Fisher's exact test was used. The selected level of significance was 0.05.

Results

On the four farms, there were 3456 deliveries, 2874 of which were normal deliveries (Table 1). The incidence of RFM for all deliveries (normal and abnormal) was 10.6% (Table 1). Among farms, the incidence ranged ($p < 0.005$) from 7.4 to 17.0%. Following normal deliveries, the incidence of RFM was 9.9%, with a range of 8.1 to 16.6% ($p < 0.005$) (Table 1).

Factors Associated with Retained Fetal Membranes

Because of the variation in incidence of RFM among farms, a search for factors influencing the incidence of RFM was carried out within each farm.

a) *Abnormal Delivery*

Dystocia was associated with a higher ($p < 0.025$) incidence of RFM than normal delivery at farm A only (Table 2). Abnormal deliveries without dystocia (e.g. abortion, stillbirth, twinning) were not associated with a significantly higher incidence of RFM than normal deliveries. Mares which delivered twins (with and without dystocia) also did not have increased incidence of retained fetal membranes.

b) *Weak or Diseased Foal*

Delivery without dystocia of a live but weak or diseased foal was not associated with increased incidence of RFM when compared with normal delivery of a healthy foal (Table 2). The following factors were studied only on normal deliveries with or without retained fetal membranes.

TABLE 3
Incluence of Age, Foaling Season and Sex of Foal on Incidence of Retained Fetal Membranes (RFM)[a] in Standardbred Broodmares with Normal[b] Deliveries

	Farm A % RFM (n[c])	Farm B % RFM (n)	Farm C % RFM (n)	Farm D % RFM (n)
Age of Mare (years)				
< 6		10.2 (98)	14.3 (49)	11.2 (98)[e]
≥ 6 < 11	NA[d]	5.8 (344)	17.2 (157)	17.2 (186)
≥ 11 < 16		8.6 (175)	12.1 (83)	15.7 (108)
≥ 16		8.8 (57)	7.7 (39)	34.4 (32)[e]
Season				
before Jan. 1	11.4 (70)	9.7 (72)		19.2 (26)
Jan., Feb., March	8.4 (453)	7.8 (347)	15.4 (117)	11.7 (222)[f]
after March 31	7.8 (874)	6.0 (284)	12.9 (225)	21.8 (188)[f]
Sex of Foal				
colt	9.2 (656)	6.6 (334)	13.6 (140)	19.1 (210)
filly	7.2 (737)	8.0 (351)	8.7 (115)	14.4 (222)

[a]RFM = retained fetal membranes for three hours or more after delivery
[b]Normal delivery = natural birth of a single live foal at term with a grossly normal placenta, and without dystocia or gross injury to the foal or dam
[c]n = number of deliveries studied
[d]NA = data not available
[e,f] = Significant ($p < 0.05$) differences between groups marked with the same superscript

TABLE 4
Influence of Previous Foaling and Breeding Status on Incidence of Retained Fetal Membranes (RFM)[a] in Standardbred Broodmares with Normal[b] Deliveries

Previous Year Status	Farm A % RFM (n[c])	Farm B % RFM (n)	Farm C % RFM (n)	Farm D % RFM (n)
Maiden		7.0 (142)		10.5 (67)
Barren	NA[d]	11.1 (126)	NA	11.7 (77)
Foaling		6.6 (319)		19.3 (207)
Foal heat bred	8.7 (358)	6.0 (184)	11.8 (85)	14.0 (93)
Not foal heat bred	6.4 (47)	6.4 (109)	25.6 (39)	23.9 (113)
RFM year before	28.6 (35)[e]	27.3 (11)[f]	50.0 (8)[g]	31.6 (19)
no RFM year before	5.9 (356)[e]	6.3 (176)[f]	12.0 (92)[g]	13.1 (84)

[a]RFM = retained fetal membranes for three hours or more after delivery
[b]Normal delivery = natural birth of a single live foal at term with a grossly normal placenta, and without dystocia or gross injury to the foal or dam
[c]n = number of deliveries studied
[d]NA = data not available
[e,f,g]Significant differences between groups marked with the same superscript; $p < 0.005$, $p < 0.01$, $p < 0.05$ for e,f,g, respectively

c) *Age*
There was no difference in the incidence of RFM among four age groups of mares (< 6 years, ≥ 6 and < 11 years, ≥ 11 and < 16 years, ≥ 16 years) on farms B and C. However, on farm D, mares over 15 years old had a significantly higher ($p < 0.05$) incidence of RFM than mares under six years of age (Table 3). Age of mares was not available for farm A.

d) *Season*
There was no seasonal influence on the incidence of RFM on three of the four farms. On farm D there was a higher ($p < 0.05$) incidence of RFM after March 31 than during January, February and March (Table 3). Mares older than 15 years at farm D did not account for this increased incidence of RFM after March 31. The percentage of mares over 15 years old foaling after March 31, was similar to that for other age groups of mares.

e) *Sex of Foal*
The normal delivery of a colt was not followed by a higher incidence of RFM than the normal delivery of a filly (Table 3).

f) *Previous Breeding History*
On farms B and D (the only farms where these data were available) there was no difference in incidence of RFM among mares which, the year before, had been barren, maiden, or foaling (Table 4). Within each of the four farms, mares which had been bred at FH during the previous year did not have a significantly different incidence of RFM than foaling mares which had not been bred at FH the year before.

g) *Previous History of Retained Fetal Membranes*
For two consecutive foalings, and not more than two, mares on farms A, B, and C which experienced RFM

TABLE 5
Pregnancy and Foaling Rates of Standarbred Broodmares after Normal[a] Deliveries With and Without Retained Fetal Membranes (RFM)[b]

Farm	A		B		C		D	
	No RFM	RFM	No RFM	RFM	No RFM	RFM	No RFM	RFM
Pregnancy rate after first breeding								
% pregnant	46.7	50.9	51.4	44.2	46.7	42.9	50.9	41.4
(number mares bred)	(1222)	(112)	(566)	(43)	(289)	(42)	(350)	(70)
Pregnancy rate after breeding season								
% pregnant	90.8	91.9	84.7	85.4	80.7	82.1	88.0	83.8
(number mares bred)	(1211)	(111)	(563)	(41)	(275)	(39)	(334)	(68)
Pregnancy loss rate								
% lost								
(number pregnant mares)	12.5 (1072)	12.0 (100)	7.1 (364)	12.0 (25)	13.7 (190)	24.1 (29)	11.7 (179)	16.3 (43)
Foaling rate								
% foaled	79.0	80.0	75.3	71.0	66.9	59.5	75.2	73.5
(number mares bred)	(1187)	(110)	(449)	(31)	(245)	(137)	(210)	(49)

[a]Normal delivery = natural birth of a single life foal at term with a grossly normal placenta, and without dystocia or gross injury to the foal or dam
[b]RFM = retained fetal membranes for 3 hours or more after delivery

TABLE 6
Pregnancy and Foaling Rates of Standardbred Broodmares with Retained Fetal Membranes (RFM)[a] and Normal[b] Deliveries With or Without Intrauterine Therapy

	No Intrauterine Therapy	Intrauterine Therapy
Pregnancy rate after first breeding		
% pregnant	42.3	41.2
(number mares bred)	(104)	(51)
Pregnancy rate after breeding season		
% pregnant	79.2[c]	93.6[c]
(number mares bred)	(101)	(47)
Pregnancy loss rate		
% lost pregnancies	7.0[d]	30.0[d]
(number pregnant mares)	(57)	(40)
Foaling rate		
% foaled	68.0	65.1
(number mares bred)	(78)	(43)

[a]RFM = retained fetal membranes for three hours or more after delivery
[b]Normal delivery = natural birth of a single live foal at term with a grossly normal placenta, and without dystocia or gross injury to the foal or dam
[c,d]Significant differences between groups with the same superscript: $p < 0.05$, $p < 0.005$ for c, d respectively

the year before had a higher ($p < 0.05$) incidence of RFM than mares which had not had RFM the year before (Table 4).

Effect of Retained Fetal Membranes on Reproductive Performance

After normal deliveries without RFM, the PR1, PRO, PLR, and FR were 48.4, 87.8, 11.5, and 76.5% respectively. There were significant differences among the farms for PRO, PLR, and FR. For this reason, when the mares which had normal delivery without RFM were used as a point of comparison for the reproductive parameters, the comparisons were made within each farm.

Within each farm, the reproductive performance of mares which had RFM and a normal delivery were not statistically different from those of mares which had a normal delivery without RFM (Table 5).

For mares having had RFM with normal delivery, the PR1, PRO, PLR and FR were 46.1, 87.3, 14.7 and 74.0% respectively, and did not differ significantly among the farms (Table 5). Therefore, the data from the different farms were pooled to analyse the effect of duration of RFM on breeding parameters.

All farms combined, there was no statistical differences between the reproductive parameters of mares which had RFM for less than eight hours and those of mares which had RFM for eight hours or longer. There also were no significant differences among the reproductive parameters of three categories of RFM (≥ 3 and < 7 hours, ≥ 7 and < 11 hours, and ≥ 11 hours).

TABLE 7
Effect of Oxytocin Therapy[a] on Duration of Retained Fetal Membranes (RFM)[b] in Standardbred Broodmares with Normal[c] Deliveries

	Farm A (Oxytocin Used)	Farm C (No Oxytocin Used)
Number of RFM ≥ 8 hours	24	28.
Total number of RFM with known duration	123	51
% RFM ≤ 8 hours	19.5[d]	54.9[d]

[a]On farm A oxytocin was injected at two hours after delivery of the foal and every two hours thereafter until expulsion of retained fetal membranes. On farm C no oxytocin was used
[b]RFM = retained fetal membranes for three hours or more after delivery
[c]Normal delivery = natural birth of a single live foal at term with a grossly normal placenta, and without dystocia or gross injury to the foal or dam
[d]Significant ($p < 0.005$) difference between groups with the same superscript

TABLE 8
Pregnancy and Foaling Rates of Standardbred Broodmares with Retained Fetal Membranes (RFM)[a] after Normal Deliveries[b], analysis with Respect to "Foal Heat" Breeding[c]

	Bred at Foal Heat	Not Bred at Foal Heat
Pregnancy rate after first breeding		
% pregnant	44.3	49.5
(number mares bred)	(167)	(101)
Pregnancy rate after breeding season		
% pregnant	87.1	87.4
(number mares bred)	(163)	(95)
Pregnancy loss rate		
% lost	16.0	12.3
(number of pregnant mares)	(131)	(65)
Foaling rate		
% foaled	71.9	75.0
(number mares bred)	(153)	(76)

[a]RFM = retained fetal membranes for three hours or more
[b]Normal delivery = natural birth of a single live foal at term with a grossly normal placenta, and without dystocia or gross injury to the foal or dam
[c]Foal heat breeding was defined as the insemination of a mare during the first 20 days delivery

No cases of laminitis, toxemia, or acute metritis were observed following retained fetal membranes.

Effect of Intrauterine Therapy on Reproductive Performance

The mares with RFM which had received intrauterine therapy had a higher ($p < 0.05$) PRO and PLR than mares with RFM which had received no intrauterine therapy. The end result was a similar FR in the two groups (Table 6).

The percentage of mares with fetal membranes retained eight hours or longer was lower ($p < 0.005$) on farm A (19%) where oxytocin was used starting at two hours postpartum than on farm C (55%) where no oxytocin was used to treat RFM (Table 7).

Effect of Foal Heat Breeding on Reproductive Parameters:

For all farms combined, the PR1, PRO, PLR, and FR of mares with RFM and bred at FH did not differ significantly from those of mares with RFM which were not bred at FH (Table 8).

Discussion

In this study, abortion, stillbirth, twinning, and delivery of a weak or diseased foal were not accompanied by an increased incidence of RFM when the delivery occurred without dystocia. However, deliveries with dystocia were associated with an increased ($p < 0.05$) incidence of RFM at farm A where large numbers of dystocias were observed. Dystocia, with

resulting abnormal uterine contractions, has been reported to increase incidence of RFM (5).

The sex of the foal did not influence the incidence of RFM in this study. This differs from the cow where an increased incidence of RFM was observed after delivery of a male calf (8) and this was attributed to the heavier weight of the bull calf and the increased incidence of dystocia. In our study, only farm A reported enough dystocias to allow statistical analysis. Twenty-seven of 774 fillies and 36 of 690 colts were delivered with dystocia. The difference was not statistically significant. This may explain why the incidence of RFM was not increased with delivery of a colt. Foal weights were not available from the farm records and so relation of RFM to increased foal weight could not be studied.

The age of the dam had no influence on the incidence of RFM in two of three farms. At farm D mares older than 15 years had a higher incidence than mares less than six years of age. No reason could be found to explain this difference at farm D. In cattle, the incidence of RFM increases with parity (6,8). One reason may be that older cows are predisposed to parturient paresis which in turn predisposes to uterine inertia and retention of fetal membranes (11). However, parturient paresis, as observed in the cow, is not seen in the mare.

Season had no influence on the incidence of RFM at three of four farms. At farm D, the months of April, May, and June were associated with a higher incidence of retained fetal membranes. This farm was situated at a more northerly latitude than the others. Longer winter confinement in stables, resulting in less exercise, may be a contributing factor in these mares, as has been suggested for stabled cattle (7).

The relation between the 30 different stallions involved in this study and incidence of RFM in the mares was not evaluated; however, it is a factor which merits investigation.

The previous breeding status had no influence on the incidence of RFM whether the mares were maiden, barren, foaling, or bred at foal heat. This may be due to the breeding management on the farms. Previous observations on increased incidence of RFM in barren mares with low fertility and mares bred at FH were made in conditions of natural breeding (4). All mares in this study were bred by AI near ovulation time with minimal trauma and contamination.

Natural breeding might be associated with greater contamination of the reproductive tract, hence a higher incidence of uterine infections and subsequent development of abnormal uteroplacental attachment. Such attachment might predispose to retained fetal membranes. The minimal trauma and contamination associated with AI, as well as the use of extenders containing antibiotics, might prevent reinfection or help resolve current infections in barren mares and so prevent development of abnormal uteroplacental adhesions. Likewise in mares bred at FH, at a stage when the uterus is still undergoing involution, breeding by AI might decrease the likelihood of developing uterine infection and the sequelae mentioned above.

Retained fetal membranes had a tendency to occur in an individual mare more than once. There was a threefold increase in mares which experienced RFM the year before. Recurrences of RFM were observed after consecutive normal deliveries suggesting that certain mares had a predisposition to retained fetal membranes. Mares with recurring RFM might have different hormonal profiles at foaling, accounting for their inability to expel the fetal membranes soon after delivery of the foal. Abnormal uterine contractions may also play a role (5). Another explanation would be that mares with recurring RFM have developed adhesions between the uterus and the allantochorion following uterine infections (20). These infections could recur year after year due to conditions like poor conformation of the vulva or early reopening of Caslick closure prior to parturition. Further investigations are necessary to determine whether or not these hypotheses was valid.

Knowing that RFM is likely to recur at subsequent foalings, mares which had RFM the year before could be treated immediately after delivery with oxytocin to prevent recurrence. It could be argued that such preventive therapy is not warranted as, in this study, RFM with normal delivery was not found to have a significant effect on subsequent reproductive efficiency. However, as discussed in the next section, it is precisely such optimal management in the form of preventive therapies or rapid interventions that may be responsible for maintenance of reproductive efficiency in mares with RFM in this study.

After foaling, RFM is considered a serious complication because of the rapidity with which metritis and toxemia develop (1,9). In our study, RFM with normal delivery had no ill effect on the reproductive or general health of the mares. Many reasons can be invoked to explain these findings:

1) the foaling facilities and hygiene on each farm were optimal, thus reducing the incidence of puerperal infections;

2) foaling assistance was provided by skilled staff who would detect, correct, or report promptly to the resident veterinarian any potential or existing problems during parturition;

3) most mares with RFM were treated with intrauterine antimicrobials and/or systemic antibiotics and/or systemic oxytocin within eight hours of foaling in order to promote expulsion of the fetal membranes or prevent development of uterine infections;

4) mares were bred by AI near ovulation time using adequate amounts of semen with minimal trauma and contamination. One study showed higher conception and foaling rates when mares with reproductive problems were bred by AI (21).

Postfoaling laminitis was not observed (3). It is likely that treatment of factors predisposing to postfoaling laminitis have contributed to the absence of laminitis in this retrospective study (3).

The method of therapy of RFM had a significant influence on some of the breeding parameters. The PRO increased after intrauterine therapy, but the PLR also increased. This resulted in a FR similar to that of mares with RFM treated systemically or not treated.

The increased pregnancy rate after uterine therapy was attributed to the antibacterial effect of the infused drug (17). In diminishing the number and activity of

uterine microorganisms, uterine therapy helped the endometrium provide a favorable medium for embryo survival and growth until the time of pregnancy diagnosis. There is evidence that uterine infusions in the mare may produce an inflammatory response (22). If such a reaction occurred in these cases, it appears to have had a short-term beneficial effect. However, the beneficial effect of uterine therapy on PRO was counteracted by an increase in fetal loss rate. There are several possible reasons for this:

1) bacteria present or introduced into the uterus at breeding or during the treatment could have caused abortion (23);

2) regrowth of bacteria could have occurred in the progestational uterus after loss of the antibacterial effect of the infused drug (in the cow the uterus under progesterone influence is more susceptible to infection) (24);

3) lesions to the endometrium caused by infused drugs could have adversely affected placental attachment and maintenance of pregnancy (25);

4) the residues of the infused drugs could have been embryotoxic and caused fetal death. Studies on tissue cell cultures have demonstrated that some of the antibiotics commonly used for uterine therapy could decrease the division rate of cells by 50% at levels three to ten times the dose required to control bacterial growth (26). In addition, it is also possible that some of the mares which were selected by the veterinarian to receive uterine treatment already had uterine damage that prevented them from carrying a foal to term, and that the treatment had no effect on the outcome of pregnancy. These results point to a need for more studies on the effect of, and indications for, uterine therapy in the mare.

The percentage of mares with fetal membranes retained eight hours or longer was lower on farm A where oxytocin was used starting at two hours postpartum, than on farm C where no oxytocin was used to treat retained fetal membranes. These results support the clinical use of oxytocin to promote expulsion of retained fetal membranes.

Foal heat breeding of mares with RFM has been considered inadvisable (4,9,15). The results of our study suggest that FH breeding can be performed in mares with RFM and normal delivery without decreasing reproductive efficiency. However, on these farms AI was used and mares bred at FH were generally selected on the basis of a normal genital tract on palpation and normal cervical discharge. These factors are likely to have biased the data. Elimination of this bias was not possible in our study but could be easily accomplished in a prospective study.

In general, the results of our study strongly suggest that RFM alone does not significantly affect the health or reproductive efficiency of mares bred by AI and maintained under close veterinary supervision regardless of the duration of retained fetal membranes. These findings are compatible with earlier studies in the cow (8,11,12). CVJ

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